RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

EDITOR

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Reversibility in Ulcerative Colitis

Clinical and Roentgenologic Observations[1]

JOSEPH B. KIRSNER, M.D., WALTER L. PALMER, M.D., and ARTHUR P. KLOTZ, M.D.

Chicago, Ill.

ULCERATIVE COLITIS is recognized as a chronic disease, varying in clinical severity and characterized by remissions and exacerbations (1). In some patients the illness is relatively mild; the process seems limited to the rectum and rectosigmoid, as judged proctoscopically, and the roentgenologic examination is normal. In others the clinical symptoms are severe; the proctoscopic changes are more pronounced; varying involvement of the colon is demonstrable by x-ray. In still other patients the bowel appears roentgenologically to be extensively and irreversibly diseased; yet clinically the manifestations may be minimal. The clinical features have been thoroughly described by Bargen (2). The tendency of ulcerative colitis to progress and the high incidence of complications have been stressed repeatedly. The potential reversibility of the disease, on the other hand, has received little emphasis.

The purpose of this paper is to direct attention to the pronounced improvement and complete healing of ulcerative colitis observed in a representative group of 24 medically treated patients in whom recent follow-up studies were made. The diagnosis in each case was established on the basis of characteristic clinical, proctoscopic, and roentgenologic evidence and the exclusion of all known pathogenic agents. The demonstration of reversibility in ulcerative colitis assumes significance in relation to therapy and in the implication it presents for the ultimate clarification of this poorly understood disease.

ULCERATIVE COLITIS: NORMAL ROENTGEN FINDINGS; COMPLETE HEALING

Roentgen examination of the colon is normal in approximately one-third of patients with ulcerative colitis. The clinical course, though it may be severe, usually is comparatively mild. In the following three cases, illustrative of a much larger group, healing was manifested in the subsidence of symptoms and proctoscopic findings. Two patients have remained well for approximately seven years. Ulcerative colitis probably is more common than is generally realized; perhaps many cases follow a benign course as observed in these three examples. In the absence of roentgen changes, the diagnosis depends largely upon the proctoscopic examination.

S. K., a 44-year-old salesman, had symptoms of ulcerative colitis in 1929; ten to twelve bloody stools were passed daily. Treatment with acri-

[1] From the Frank Billings Medical Clinic, Department of Medicine, University of Chicago. Presented at the Thirty-Sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10–15, 1950.

This study was supported in part by the Wallach Fund for Research in Ulcerative Colitis.

flavine and stovarsol was ineffective. Prolonged rest resulted in definite improvement, although gross blood persisted in the feces. Proctoscopy demonstrated a finely granular, friable mucosa. The rectal mucosa appeared normal in November 1932. Another recurrence in August subsided with bed rest and the patient remained in good health until April 1936, when the rectal mucosa again was very friable. Symptoms persisted until January 1938 and then subsided after bed rest and the use of a bland diet and antispasmodics. The patient has been in excellent health since 1940. The rectal mucosa has appeared practically normal since 1943. One or two formed stools are passed daily. Four roentgen examinations during the period 1931 to 1947 have demonstrated a normal colon.

A. N., a 36-year-old machinist, had noticed gross blood in the feces for a six-week period in 1940. In February 1943 the number of bowel movements increased to four or five daily and the feces again contained gross blood. In April 1943 proctoscopy demonstrated a granular rectal mucosa with numerous bleeding points in the distal 15 cm. Treatment with a bland diet, sedatives, and antispasmodics was followed by gradual improvement over a period of six months. The rectal mucosa appeared almost normal in October 1943 and entirely normal in April 1944. There was no recurrence during a severe emotional disturbance in April 1948. Proctoscopy demonstrated a normal bowel in January 1949. The patient remains in good health. Roentgen examination of the colon has been normal.

E. S., a 12-year-old girl, had suffered from constipation during early childhood. Gross blood and mucus were noticed in the feces in 1947 and persisted for two months. Roentgen examination of the colon was reportedly normal. Bleeding recurred a year and a half later; the diagnosis of ulcerative colitis was established on the basis of proctoscopy. Diarrhea, with four to six stools daily, and fever developed before admission to the hospital in July 1950. The abdomen was diffusely tender. The hemoglobin was decreased to 9.8 gm. Proctoscopy demonstrated an edematous, friable, bleeding mucosa. The temperature rose daily to 100 or 101° F. Therapy consisted of a bland diet, tincture of belladonna, and two blood transfusions; sulfaguanidine was administered later in doses of 4 gm. daily. There was progressive clinical improvement after several weeks. The stools became formed, but traces of blood persisted; the appearance of the rectal mucosa was not changed significantly. Treatment was maintained at home with continued improvement. The patient now (June 1951) is in excellent health and has resumed her normal activities. One formed stool is passed daily. The rectal mucosa at present is finely granular; all evidence of friability has disappeared. Roentgen examination of the colon remains normal.

SEVERE ULCERATIVE COLITIS
COMPLETE HEALING

Complete reversibility of extensive ulcerative colitis has been reported very infrequently (1–3). The following four cases are of interest because of the severity of the disease clinically, proctoscopically, and roentgenologically, and the complete disappearance of the roentgen changes. One patient (L. G. H.) improved while awaiting an ileostomy which subsequently was not required. In a second case (R. K), also, surgical intervention had been recommended elsewhere. Two patients (L. G. H. and E. F.) have remained well for eleven and ten years respectively. Therapy consisted basically of prolonged rest, sedation, and restoration of normal nutrition. Sulfaguanidine was strikingly effective in E. F. Psychotherapy seemed decisive in R. K. The administration of ACTH appeared to be of paramount importance in M. S.; the disappearance of extensive ulcerations of the colon in this case was spectacular.

L. G. H., a 36-year-old housewife, noticed gross blood in the feces in January 1934, at the age of twenty. An appendectomy in March was followed by severe bloody diarrhea which did not respond to anti-amebic therapy. The patient lost 32 pounds in weight and was acutely ill. The erythrocyte count was 2,900,000, hemoglobin 8.3 gm., and leukocyte count 20,000; the plasma proteins totaled 4.8 gm. per cent (normal 6–8), albumin 2.0, and globulin 2.8 gm. Proctoscopy confirmed the presence of severe ulcerative colitis. Treatment consisted of rest, blood transfusions, sedatives, and antispasmodics. Symptoms subsided only partially after one month and an ileostomy was scheduled. Operation was delayed, however, by an upper respiratory infection. During the interval the patient improved greatly and gained 22 pounds. Bowel movements became formed; the blood count and plasma proteins returned to normal. The patient was discharged after 233 days. Except for a mild recurrence in 1939, she has remained in excellent health to date (June 1951). The rectal mucosa has appeared normal since 1942.

Roentgen examination in November 1934 disclosed shortening, narrowing, and absence of haustrations throughout the entire colon. In April 1935 the colon was more pliable. Haustrations were visible in the ascending colon in October 1935. Increasing improvement was noted in August 1936 and February 1937. The only demonstrable change in February 1938 was an abnormal mucosal pattern.

In July 1938 the examiner reported: "I would not suspect ulcerative colitis from these films." Examinations in 1939, 1941, 1942, and 1944 demonstrated only a mild pseudo-polypoid mucosal pattern. In August 1945 the colon was regarded as normal except for coarse mucosal folds; the most recent roentgen study, in November 1950, demonstrated an entirely normal colon (Fig. 1).

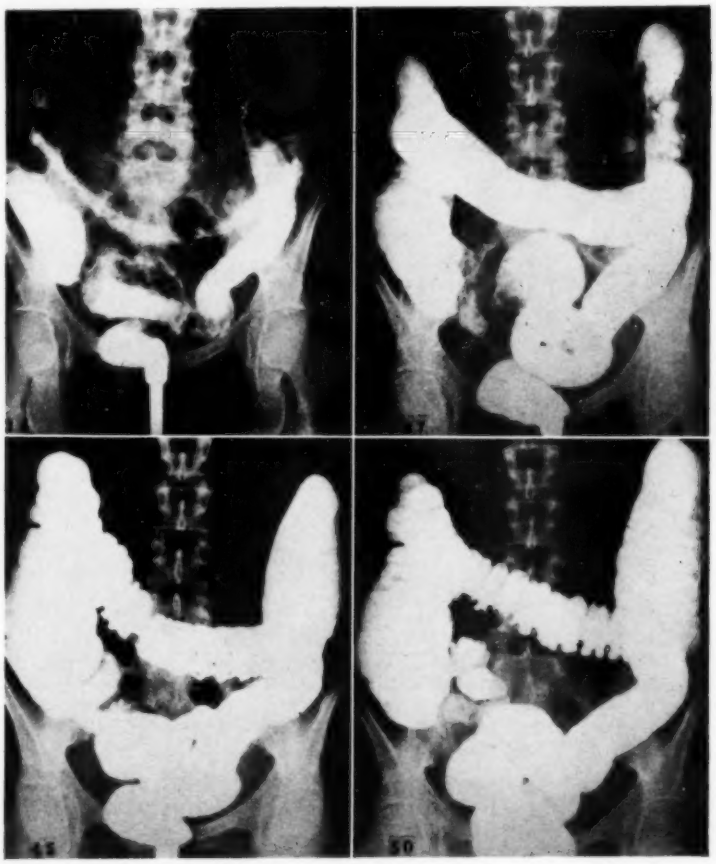

Fig. 1. L. G. H. Reversal of roentgen changes of ulcerative colitis. Severe disease in 1934; normal colon in 1950.

E. F., a 42-year-old female chemist, had symptoms of ulcerative colitis, developing in 1938. The course was not altered significantly during five months of hospitalization and treatment with a bland diet, sedatives, and antispasmodics. Six to twelve watery bowel movements, occasionally containing gross blood, occurred daily. Proctoscopic evidence of active colitis persisted. Symptoms subsided dramatically in 1940 upon the administration of sulfaguanidine. Improvement has been maintained, although the quantity of the drug was reduced progressively from 10 to 0.5 gm. daily. The patient has remained in excellent health for approximately ten years; her diet is unrestricted. Frequent proctoscopies have demonstrated complete healing of the colitis; examination in November 1950 indicated a normal rectal and sigmoidal mucosa.

Roentgen study in April 1939 disclosed involvement of the entire large bowel and terminal ileum, characterized by contraction, complete loss of haustrations, and marginal serration. In August 1939 undermined ulcerations were noted in the ascending and transverse segments; the mucosal pattern was grossly abnormal. The roentgen appearance was not changed significantly in 1940, 1944, and 1945. Occasional shallow haustrations were observed in May 1946. Haustral markings were more definite in May 1947 and extended over larger segments of the bowel; there was no marginal serration. In November 1950 the colon was normal roentgenologically; the terminal ileum also appeared normal (Fig. 2).

R. K., a 14-year-old boy, first experienced symptoms of ulcerative colitis in March 1947. Symptoms

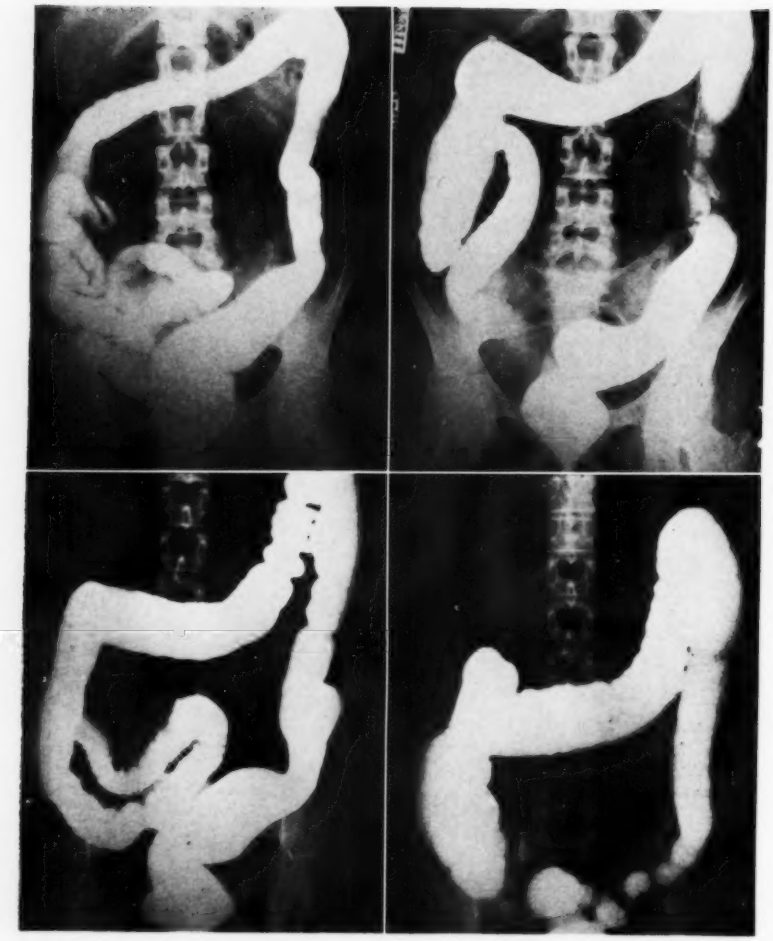

Fig. 2. E. F. Reversal of roentgen changes of ulcerative colitis. Involvement of entire colon in 1939; essentially normal colon in 1950.

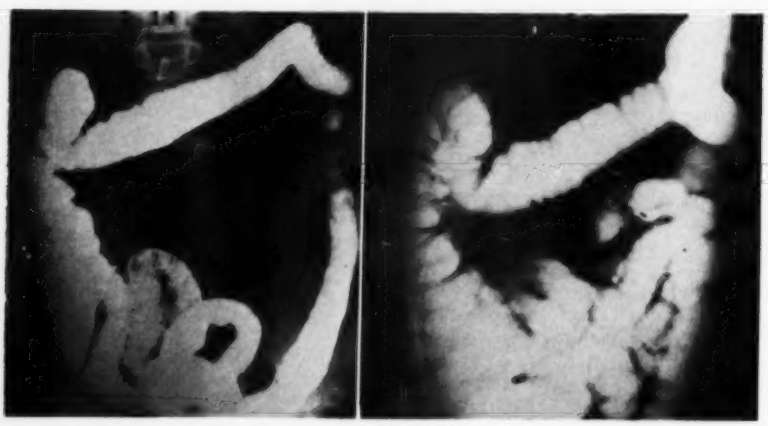

Fig. 3. R. K. Reversal of roentgen changes of ulcerative colitis. Extensive disease in 1949; normal colon in 1950.

recurred in July 1947 and persisted despite five periods of hospitalization and therapy including blood transfusions, sulfonamides, vaccines, and an extract of mucosa from hog's colon. Examination elsewhere was reported to have shown advanced ulcerative colitis of the entire bowel, with considerable deformity and moderate shortening. Surgical treatment was suggested.

The patient, when first seen at the University of Chicago Clinics in September 1948, had lost 25 pounds in weight. The temperature was moderately elevated. The erythrocyte count was reduced to 3,300,000; hemoglobin to 8 gm., and the total plasma proteins to 5.8 gm. per cent. Severe ulcerative colitis was demonstrable at proctoscopy. The patient remained in the hospital approximately five months. Treatment consisted of blood transfusions, a high-caloric diet, sedatives, vitamins, and sulfaguanidine. Symptoms subsided gradually; bowel function returned to normal, and proctoscopic evidence of the disease abated. The care provided by an intelligent psychiatrist appeared to be of particular importance in promoting recovery. The patient remains in excellent health; he has gained in weight from 86 pounds in September 1948 to 167 pounds in December 1950. The rectal mucosa has appeared normal since April 1949. Roentgen study in January 1949 demonstrated involvement of the entire colon. In June 1950 the colon was completely normal (Fig. 3).

M. S., a 50-year-old dentist, had had frequently recurrent ulcerative colitis for six years, with therapy including azosulfamid, sulfaguanidine, streptomycin, and aureomycin. He re-entered the hospital in April 1950, because of a severe exacerbation. Proctoscopy demonstrated a friable, ulcerated mucosa. The course of the disease was unchanged during the use of a bland diet, phenobarbital, belladonna, and sulfadiazine. The abdominal distress and bloody diarrhea subsided promptly after the administration of ACTH; a total of 2,310 mg. was given in thirty-seven days. Proctoscopic evidence of the disease subsided after one month of treatment. The patient remains in excellent health and has resumed normal activity; one formed stool is passed daily. Proctoscopy in January 1951 indicated a practically normal rectal mucosa.

Roentgen examination in May 1950 disclosed spectacular, deep, ragged ulcerations extending from the distal transverse colon to the rectosigmoid junction, loss of haustrations, and diminished caliber of the bowel. In July 1950 the ulcerations had disappeared, marginal serration was minimal, and the colon was fairly well haustrated. A similar appearance was noted in October 1950 (Fig. 4).

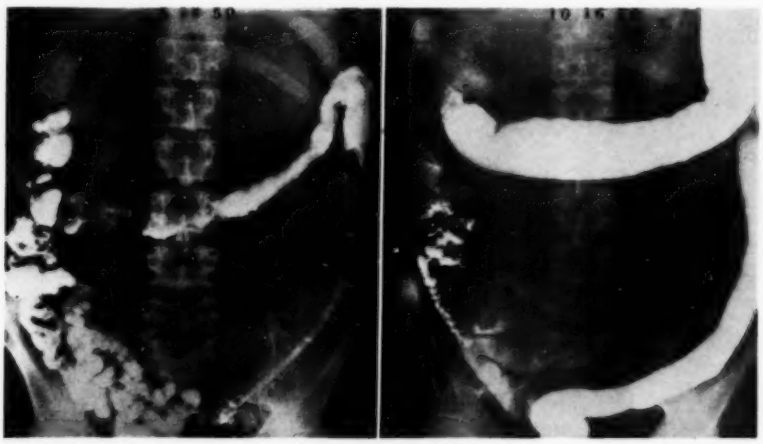

Fig. 4. M. S. Spectacular ulceration of colon in May 1950, with disappearance of ulceration in October 1950.

SEVERE ULCERATIVE COLITIS: COMPLETE HEALING CLINICALLY; PRONOUNCED ROENTGEN IMPROVEMENT

Colitis was severe in the following 7 patients. Five of the group were seriously incapacitated; 3 required hospitalization for periods totaling 185, 224, and 742 days, respectively. The x-ray manifestations of the disease, though extensive, regressed markedly. Patient N. B. is of added interest in that a rectal stricture eventually resolved and was no longer demonstrable.

L. M. G., a 29-year-old housewife, first noticed gross blood in the feces in January 1940; diarrhea developed several months later. Proctoscopy demonstrated an edematous, granular, friable, profusely bleeding rectal mucosa, characteristic of active ul-

cerative colitis. The patient was hospitalized for seventy-three days. Therapy included six blood transfusions and sulfaguanidine, in addition to a bland diet, sedatives, and antispasmodics. The temperature, initially reaching a peak of 103° F., gradually subsided. The diarrhea diminished but gross blood persisted in the feces. A second period of hospitalization was necessary in September 1941. The rectal mucosa was friable and covered with a mucopurulent exudate. Therapy included five blood transfusions, vitamins, sedatives, antispasmodics, and sulfonamides. Improvement occurred gradually over a period of eighty-two days. In November 1941 proctoscopy revealed an almost normal rectal mucosa. The weight increased from a low of 99 pounds to 125 pounds.

The patient remained quite well for two years; the stools were formed and the rectal mucosa was healed. Diarrhea recurred in January 1944, and the rectal mucosa again appeared friable; the colitis subsided after one month. The patient was married in December 1945. Mild relapses in 1946 and 1947 subsided promptly. A pregnancy was completed uneventfully in August 1947. Proctoscopy revealed only mild polypoid hyperplasia in occasional areas; the mucosa otherwise appeared normal. Brief, relatively mild recurrences were reported in August 1948 and January 1950; proctoscopic examination was normal, however. In August 1950 the patient was again pregnant. The bowel movements were formed, and some tendency to constipation was noted.

Roentgen examination in November 1941 demonstrated involvement of the entire colon, with a complete absence of haustrations. In December 1942 the caliber of the bowel was normal and there was no shortening. In March 1949 the colon appeared smooth, with loss of normal haustrations to the midtransverse colon. The right half of the transverse colon and the ascending portion showed haustral markings. The entire colon filled out to normal width and no other abnormalities were demonstrable. (Fig. 5).

D. N., a 36-year-old housewife, had ulcerative colitis, developing in 1941. On examination, March 1942, she was emaciated, pale, and acutely ill. The erythrocyte count was 2,000,000, hemoglobin 6 gm., and plasma proteins 5.8 gm. per cent. Proctoscopy indicated a severely ulcerated, friable mucosa. Therapy included seven blood transfusions, sedatives, and sulfasuxidine. The patient improved gradually and was discharged from the hospital after ninety-two days. In February 1943 the stools were well formed and the rectal mucosa appeared practically normal. Subsequent yearly examinations have demonstrated an essentially normal rectum and sigmoid, with occasional small polyps. The patient has gained weight and continues in excellent health; polyps were not demonstrable in November 1950.

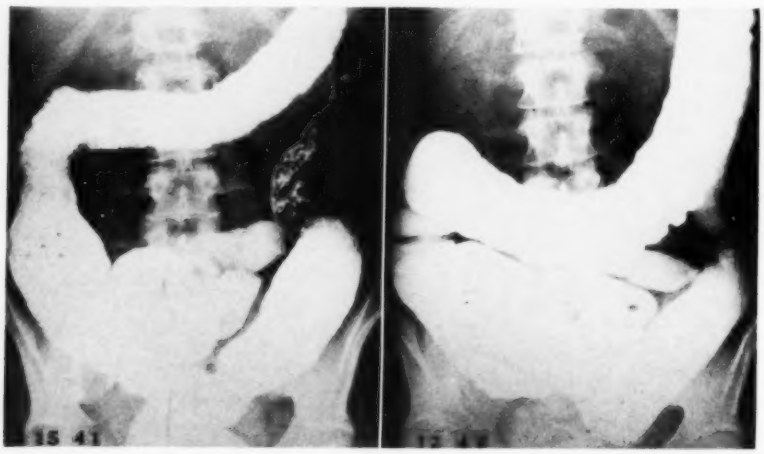

Fig. 5. L. M. G. Improvement in roentgen appearance of colon. Complete clinical recovery.

Roentgen examination in June 1942 revealed involvement of the entire colon. In June 1946 haustrations were observed intermittently throughout the course of the bowel; the descending colon was smooth. There was no significant change in July 1948. In July 1950 the colon appeared normal at fluoroscopy; questionable evidence of marginal serration was noted in the left colon; the terminal ileum, as before, was normal.

L. R., a 26-year-old female secretary, had had rheumatic fever at the age of twelve. She had experienced diarrhea during periods of excitement since childhood, and in 1942 this had become constant; eight to ten stools containing gross blood were passed daily. In 1945 the bowel movements

increased to twenty-five daily. Proctoscopy demonstrated the usual findings of active ulcerative colitis. The patient remained in the hospital for 180 days between November 1945 and May 1946. Treatment with bland diet, sedatives, antispasmodics, vitamins, sulfathalidine, and psychotherapy led to moderate clinical improvement. Symptoms increased in September 1946, and the patient subsequently was hospitalized for 562 consecutive days (Sept. 15, 1946, to March 30, 1948). Therapy, including sulfonamides, penicillin, and streptomycin, had no striking effect. Pronounced improvement accompanied skillful psychotherapy administered by a physician especially interested in these problems. The number of bowel movements diminished from twelve or fourteen to two to five daily. The patient has remained well to the present time (January 1951). She has worked effectively full time as a secretary since April 1948. One soft or well formed stool is passed daily. The rectal mucosa has appeared normal since April 1949.

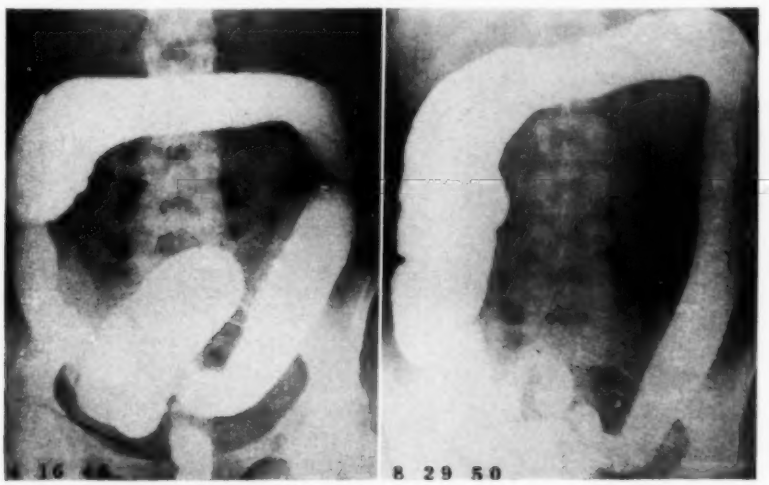

Fig. 6. N. B. Improved though persistent roentgen evidence of colitis. Complete clinical recovery.

Roentgen examination in July 1945 indicated involvement of the entire colon, with complete loss of haustrations, slight shortening, marginal serration, and an abnormal mucosal pattern. The findings were unchanged in September 1946. In January 1949 the colon was smooth but pliable; there were no marginal serrations; some semblance of a normal mucosa was observed along the ascending and proximal transverse colon. Further improvement was noted in November 1950; haustrations were more evident and there was no serration.

N. B., a 22-year-old college girl, had ulcerative colitis in 1942. She lost 50 pounds in weight; as many as fifteen watery, bloody stools were passed daily. Therapy included anti-amebic drugs, enemas, opiates, azosulfamid, sulfaguanidine, and vitamins. In Apirl 1946 proctoscopy disclosed active colitis and a rigid, tubular rectum. The patient remained in the hospital for 224 days. Prolonged bed rest and treatment with sedatives, antispasmodics, sulfathalidine, penicillin, and psychotherapy, led to gradual improvement. The patient was surprisingly well in April 1947 and had gained a considerable amount of weight; two to three formed stools were passed daily except during periods of emotional stress. Rectal examination demonstrated a stricture, approximately 1 cm. in diameter, at the apex of the rectum; the mucosa was extremely friable. In September 1947, one to three fairly well formed stools were passed daily; occasional bowel movements were 1 inch in diameter despite the pronounced narrowing of the rectum; the mucosa more closely approached normal than on any previous occasion. Proctoscopy was normal in January 1948. In August 1948 only one formed stool was passed daily. In April 1949 the patient felt "wonderful." The rectal stricture now was not demonstrable and the mucosa was practically normal. Symptoms recurred temporarily in December 1949 but subsided rapidly. The patient was in excellent health in August 1950.

Roentgen examination in April 1946 indicated involvement of the entire colon and terminal ileum, with shortening, complete loss of haustrations, marginal serration, and suggestive pseudopolyposis. There was no significant change in November 1946. In November 1948 the bowel appeared less shortened and rigid; there was no serration, and a few haustrations were observed in the cecum. In August 1950 examination demonstrated minimal shortening of the colon and a decreased number of haustrations (Fig. 6).

D. W. P., a 23-year-old male college student, had recovered from rheumatic fever at the age of thirteen and acute glomerulonephritis at twenty (February 1947). His mother had had a chronic ulcerative colitis, treated by ileostomy and subtotal colectomy; she had died of carcinoma of the rectum in June 1948. A bloody diarrhea in June 1947, attributed to *E. histolytica*, subsided after treatment with antiamebic drugs. Symptoms recurred in July 1948 and persisted despite anti-amebic therapy. The patient was severely ill; the temperature rose to 103° F.; up to twenty bloody stools were passed daily. The erythrocyte count was 2,100,000, hemoglobin 11.5 gm., and plasma proteins 5.2 gm. per cent. Repeated examination for *E. histolytica* and other pathogens was negative. The proctoscopic findings were typical of ulcerative colitis. Improvement occurred gradually after seventy-two days of treatment, which included seven blood transfusions, protein hydrolysates, glucose, and isotonic saline solutions parenterally, sulfadiazine, sulfaguanidine, and penicillin. The patient gained weight, and the laboratory findings returned to normal. In December 1949 proctoscopy revealed only mild granularity of the rectal mucosa. A mild diarrhea with rectal bleeding occurred in April 1950. Proctoscopy demonstrated three small polyps in the sigmoid. Two blood transfusions were administered. The patient subsequently has been in excellent health; one formed stool is passed daily. Proctoscopy in September 1950 revealed an almost normal mucosa and no polyps.

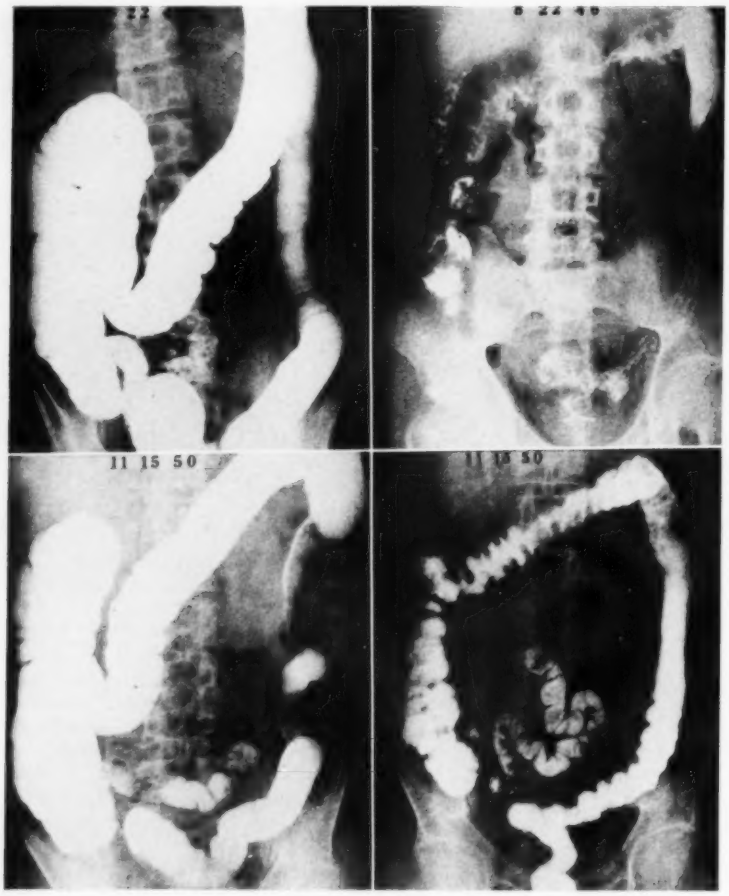

Fig. 7. M. U. Improvement in roentgen appearance of colon. Complete clinical recovery.

Roentgenograms in January 1949 indicated involvement of the entire colon, with ragged outlines, decreased caliber, loss of haustrations, conical narrowing of the cecum, and an abnormal mucosal pattern. In December 1949 examination indicated slight irregularity of the sigmoid, shortening of the

bowel, and narrowing of the cecum. In April 1950 the colon appeared essentially normal; the only abnormalities were minimal irregularity in the contour of the cecum and questionable alteration in the mucosal pattern of the sigmoid.

M. U., a 49-year-old mechanic, first experienced symptoms of ulcerative colitis in 1937. The subsequent ten years were characterized by the usual relapses related to nervous tension, physical fatigue, and respiratory infections. Proctoscopy in August 1946 revealed a friable ulcerated rectal mucosa. There was pronounced improvement after a period of rest, the use of sedatives, and a bland diet. The rectal mucosa was practically normal in March 1947. Symptoms recurred in July 1948 and again in February 1949. The patient improved markedly after treatment including two blood transfusions, sulfaguanidine, and prolonged rest. He has remained well to the present time, has resumed his normal activities, and has discontinued all medication. Bowel function is entirely normal. Proctoscopy in November 1950 demonstrated a normal rectal mucosa.

Roentgen examination in August 1946 revealed an ulcerative colitis up to the left half of the transverse colon, with smoothening, marginal serration, and an abnormal mucosal pattern. In November 1950 the colon was pliable and of normal caliber; haustrations were absent from the left half of the transverse colon, but, in contrast to the previous examination, there were no serrations and no shortening of the bowel (Fig. 7).

C. W. P., a 20-year-old male athlete, became ill in April 1948, with low-grade fever and pain in the jaws, wrists, hips, and knees. Diarrhea developed abruptly one month later, accompanied by fever, lower abdominal pain, and loss of 25 pounds in weight. Proctoscopy demonstrated the usual findings of active ulcerative colitis. The clinical course was not changed significantly during treatment with a bland diet, sedatives, penicillin, and sulfadiazine; the temperature rose to 100 or 101°F. daily. Prompt improvement accompanied the administration of sulfaguanidine in doses of 8 gm. daily. The patient remains well, two years after hospitalization, during continued treatment with phenobarbital, belladonna, and 4 gm. of sulfaguanidine daily. One formed stool is passed daily. Proctoscopy in November 1950 indicated a normal rectal mucosa.

Roentgen study in September 1948 disclosed loss of haustrations to the mid-transverse colon, slight narrowing of the left colon, probable involvement of the cecum, and an abnormal mucosal pattern. Examination in November 1950 demonstrated marked improvement; minimum residual deformity of the transverse and descending colon, and partial loss of haustrations were the only recognizable abnormalities.

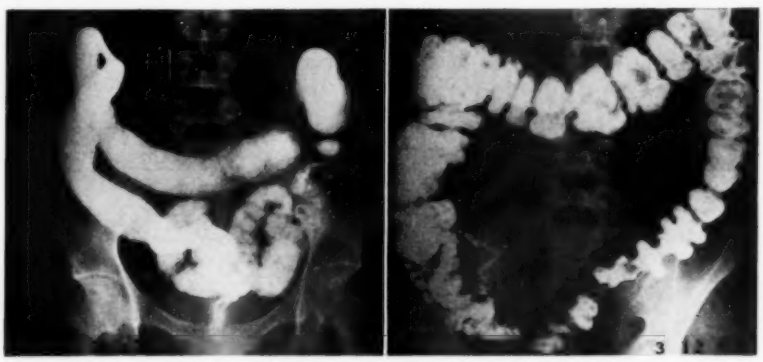

Fig. 8. M. N. Remarkable reappearance of haustrations in colon.

SEVERE ULCERATIVE COLITIS: PRONOUNCED ROENTGEN IMPROVEMENT AND SUBSEQUENT RECURRENCE

The next two cases are of interest because of the remarkable disappearance of extensive roentgen manifestations of the disease.

M. N., a 53-year-old housewife, first experienced symptoms of ulcerative colitis in 1917. The disease recurred with increasing frequency and severity despite therapy including the use of intestinal antiseptics, anti-amebic drugs, and vaccines. In 1932, twelve to fifteen bloody stools were passed daily. The patient lost 65 pounds in weight, and she was severely ill. Slight improvement accompanied two periods of hospitalization. The disease recurred and abated over the years, with gradually diminishing intensity. The patient improved in 1941; during the subsequent six years only two or three stools were passed daily. Proctoscopy in 1936 had demonstrated a contracted rectum with an ulcerated, polypoid mucosa. In January 1947 the rectum was not narrowed; the mucosa contained two small polyps; it was neither friable nor granular.

Roentgen examination in March 1932 indicated

diffuse involvement of the bowel with shortening and absence of haustrations. Haustrations reappeared in October 1933. In December 1936 the caliber of the colon was normal; the rectum appeared narrowed and the mucosa thickened. There was no significant change in 1939 or 1940. The final roentgen study in 1947 demonstrated rectal narrowing as the only residual evidence of ulcerative colitis. However, a constricting carcinoma was discovered in the mid-descending colon; the patient succumbed to this lesion in April 1949 (Fig. 8).

Y. T., a 26-year-old Japanese mechanic, noticed gross blood in the feces in February 1945. Bloody diarrhea developed in August, with fifteen to twenty stools daily. There was a loss of 40 pounds in weight. The rectal mucosa was diffusely inflamed and friable. The patient remained in the hospital for seventy-six days between December 1945 and February 1946. Therapy included several blood transfusions, sedatives, bland diet, and intensive psychotherapy. There was gradual improvement; the number of bowel movements decreased to one or two daily.

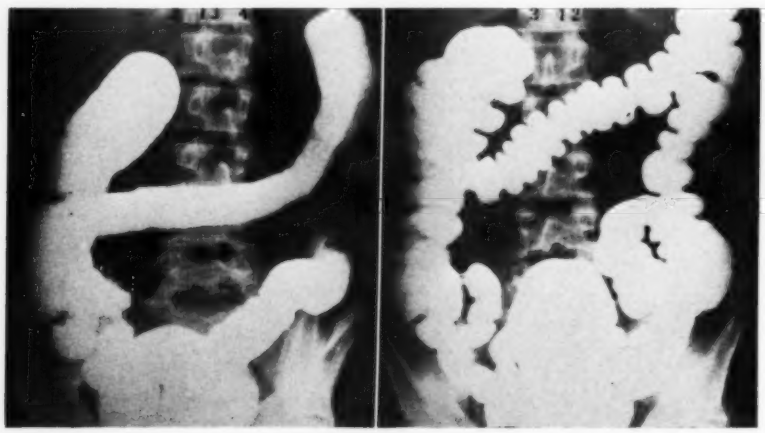

Fig. 9. Y. T. Dramatic reversal of roentgen changes of ulcerative colitis.

In January 1949 proctoscopy revealed a normal mucosa; one formed stool was passed daily. A fistula in ano was excised in July 1949. In August 1950 symptoms recurred and the rectal mucosa again was edematous and friable. The patient improved after one month of hospitalization; treatment consisted of sedatives, penicillin, and sulfaguanidine. In January 1951, one formed stool was passed daily. At proctoscopy the rectal mucosa appeared almost normal except for minimal granularity.

Roentgen study in February 1946 disclosed involvement of the left colon. In March 1947 there was no x-ray evidence of ulcerative colitis. In September 1950 the margins of the descending colon and sigmoid were slightly serrated; the terminal ileum was normal (Fig. 9).

SEVERE ULCERATIVE COLITIS: CLINICAL RECOVERY; PERSISTENT ROENTGEN CHANGES

In the following 8 cases clinical recovery ensued despite extensive disease of the bowel as demonstrated by x-ray. The resumption of normal bowel activity seems remarkable in view of the initial severity of the process and the persistent contraction and shortening of the colon; cases A. H., F. P., and M. S. are noteworthy in this regard. As in preceding patients of this series, sustained clinical recovery followed an early period of frequent severe recurrences necessitating repeated hospitalization. In M. S. the colitis had persisted for thirty years and then subsided completely; the maintenance of normal bowel function despite operations for acute intestinal obstruction and subdural hematoma in this case is of special interest. The colitis in F. B. was of unusual severity and was complicated by electrolyte and fluid depletion, and iridocyclitis. Ileostomy proved totally ineffective. Restoration of normal bowel continuity and intensive medical and psychotherapeutic care ultimately led to marked improvement. Our experience suggests that ileostomy is not curative, even though it may be performed relatively soon after the onset of the disease. A case in point is that of D. H., a 50-year-old housewife in whom an ileos-

tomy was established within six weeks after initial symptoms of ulcerative colitis. The disease, nevertheless, progressed and during a period of several years involved the entire colon; a total colectomy was performed subsequently.

P. Z., a 48-year-old housewife, had ulcerative colitis in 1927, at the age of twenty-five. Symptoms persisted despite treatment with tincture of opium, bismuth, acriflavine enemas, anti-amebic therapy, and a vaccine. Benign polyps of the rectum and sigmoid were excised in 1932 and 1933. The disease recurred and subsided in characteristic fashion. In 1937 eight to ten watery stools were passed daily. The rectal mucosa was thickened, edematous, granular, ulcerated, and covered with sanguinopurulent material. Prolonged rest and sedatives led to improvement. In February 1938 one formed stool was passed every twenty-four to forty-eight hours; the rectal mucosa now appeared normal. Symptoms recurred, however. In 1943 sulfathiazole and sulfasuxidine appeared helpful. In January 1944 the patient was in good health; the bowel movements were formed and the rectal mucosa was not friable. A severe exacerbation in August 1944 necessitated rehospitalization. The erythrocyte count was 3,000,000 and the hemoglobin 8.6 gm. Treatment included transfusions, sulfadiazine, sulfathalidine, penicillin, and sedatives. Gradual improvement occurred during 110 days of hospitalization. In October 1945, the mucosa appeared scarred but not friable. A mild recurrence in May 1947 subsided promptly with bed rest. In 1948 the rectal mucosa was only finely granular, and in April 1949 there was little proctoscopic evidence of ulcerative colitis. A recurrence in November 1949 again responded to strict bed rest. The patient has maintained a regimen of limited physical activity, sedatives, and sulfathalidine. In August 1950 she was very well; the bowel movements were formed and the mucosa was only slightly granular.

Roentgen examination in March 1932 indicated a normal colon. In 1937 the rectum and descending colon were narrowed and the mucosal pattern polypoid. There was no significant change in 1939. In 1945 the caliber of the rectum and sigmoid was increased; haustrations in the transverse colon were decreased, but there was no shortening or marginal serration. In April 1949 the left colon was moderately contracted and there were decreased haustrations.

A. H., a 22-year-old male clerk, had ulcerative colitis in 1936, at the age of eight. Seven periods of hospitalization, totaling 233 days, were required between 1936 and 1944. Therapy included diet, sedatives, blood transfusions, anti-amebic drugs, sulfadiazine, sulfathalidine, and sulfasuxidine. Proctoscopy repeatedly demonstrated active ulcerative colitis. The patient improved markedly after 1944; two or three semiformed stools were passed daily, and there was progressive gain in weight. Hospitalization was necessary in 1948 and 1949 because of three episodes of severe pain in the right lower abdominal quadrant, fever, and leukocytosis; symptoms subsided during conservative treatment with sulfadiazine, penicillin, and streptomycin. The patient has been in excellent health since April 1949, with some tendency to constipation recently. The proctoscopic appearance of the rectal mucosa has been entirely normal since December 1948. The patient was inducted into military service in October 1950.

Roentgen study in September 1936 disclosed involvement primarily of the left colon. In March 1943 the disease involved the entire colon and terminal ileum. In August 1948 marginal serration was noted along the ascending and transverse colon. In April 1949 the findings were interpreted as "old ulcerative colitis"; the terminal ileum appeared normal.

M. C. S., a 29-year-old housewife, had been treated for amebic dysentery in April 1939. In September 1940 she experienced fever, malaise, and diarrhea, gross blood appearing later. The rectal mucosa was edematous, friable, and diffusely ulcerated. The patient was severely ill. The erythrocyte count decreased to 2,600,000 and the hemoglobin to 8 gm. Treatment included sulfanilamide, sulfaguanidine, sedatives, and vitamins; 19 blood transfusions were required. Improvement was gradual, and the patient was discharged from the hospital after 148 days. Proctoscopy now indicated minimal granularity and mild friability. A recurrence in August 1941 promptly subsided with bed rest; the rectal mucosa subsequently appeared almost normal. Hospitalization for ninety-one days was required between May and August 1942. Therapy included eight blood transfusions, sulfathiazole, and sulfaguanidine. In January 1943, a recurrence of symptoms was accompanied by anemia, joint pain, and fever. The patient remained in the hospital forty days. Treatment included three blood transfusions, protein hydrolysates, and sedatives. In August 1943 the rectal mucosa appeared normal. The patient has remained in excellent health. She was married in 1945. In March 1947 the rectal mucosa again was normal. In March 1948 she gave birth to a daughter, who survived in spite of erythroblastosis. In September 1950 bowel movements were entirely normal. Proctoscopic examination to 15 cm. was normal.

Roentgen study in May 1941 demonstrated involvement of the descending colon; the changes were less pronounced one year later. In April 1947, the left colon appeared tube-like, with loss of haustrations and irregular marginal serration; pseudopolyposis was noted in the right half of the transverse colon. In September 1950, the left colon again appeared tubular and manifested a fine marginal serration; the appearance was essentially unchanged from the previous examination (Fig. 10).

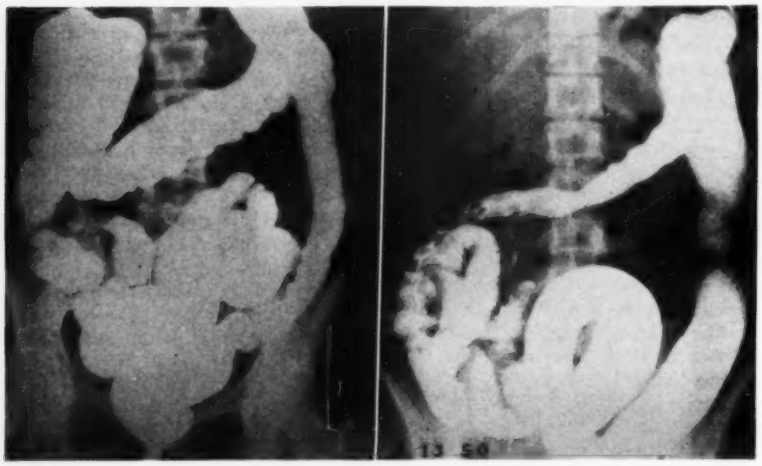

Fig. 10. M. C. S. Persistent roentgen evidence of ulcerative colitis. Complete clinical recovery.

B. G. Z., a 27-year-old housewife, had ulcerative colitis in May 1948. She passed approximately ten bloody stools daily and was markedly undernourished. Gradual improvement occurred during treatment with a bland, high caloric diet, sedatives, sulfathalidine, and, later, sulfaguanidine and thephorin. Since August 1949 the patient has remained in excellent health and has discontinued all treatment. In November 1950, she had mild constipation. Proctoscopy demonstrated a normal rectal mucosa.

Roentgen study in November 1948 demonstrated involvement of the entire colon with marginal serration and absence of haustrations. In November 1950 the colon again appeared shortened, narrowed, and without haustrations; there was no marginal serration.

F. P., a 38-year-old housewife, developed a bloody diarrhea in 1931, at the age of nineteen. The number of bowel movements varied from four to fifteen daily. A severe recurrence with profuse rectal bleeding necessitated hospitalization in December 1939, blood transfusions, and sulfonamides. Frequent relapses during the subsequent seven years were accompanied usually by severe bleeding. Therapy included vaccines, opiates, sedatives, azosulfamid, and blood transfusions. The patient was referred to the University of Chicago Clinics in November 1946 for possible surgical treatment. Rectal and proctoscopic examinations disclosed active colitis, polypoid hyperplasia of the rectal mucosa, and a membranous stricture immediately proximal to the anal ring; treatment consisted chiefly of rest, a bland diet, and sedatives. In July 1947 the patient was greatly improved; one or two formed stools were passed daily and several days might elapse without a bowel movement. In November 1947 the patient stated that she felt better than in sixteen years. Bowel movements were well formed, occurred once every three days, and were at least 1 inch in diameter. Proctoscopy now indicated a scarred but otherwise normal-appearing rectal mucosa. In 1948 the patient successfully completed a normal pregnancy, with the birth of a daughter. Mineral oil was necessary in August 1949 because of constipation. A rectal abscess in 1950 healed promptly after incision and drainage. The patient continues in good health (1950) and is leading a normal life. The bowel movements are well formed and average no more than one every one to three days.

Numerous roentgen examinations of the colon elsewhere between 1936 and 1942 demonstrated involvement of the entire large bowel with the characteristic findings of chronic ulcerative colitis. In 1946 and 1947 the entire colon was stiffened, shortened, and intermittently narrowed; the terminal ileum was normal.

M. S., a 62-year-old business man, had been operated upon for a ruptured appendix and peritonitis in 1904, at the age of sixteen. One year later he recovered spontaneously from an episode diagnosed as intestinal obstruction. Diarrhea of moderate severity developed in 1917 and recurred frequently until 1947; subsequently two semiformed stools were passed daily. In October 1949 the patient appeared in good health. Proctoscopy to a distance of 25 cm. above the anal ring revealed a normal mucosa. Roentgen examination demonstrated a severely diseased colon, with shortening, rigidity, absence of haustrations, and areas of stenosis in the mid-descending and proximal transverse colon (Fig. 11). In January 1950 the patient reported only one bowel movement daily. He was

again seen in July 1950 because of cramping abdominal pain and vomiting. The clinical and roentgen findings indicated an acute intestinal obstruction. At operation a segment of terminal ileum, 1 1/2 feet in length, was almost completely strangulated by a fine adhesive band, attributable to the old ruptured appendix and peritonitis; the appendix had not been removed. The colon appeared somewhat shortened but presented no other gross abnormality. The adhesion was severed and the patient recovered uneventfully. In September 1950 he underwent a left frontoparietal craniotomy for the removal of a chronic subdural hematoma. Again he made a surprisingly uneventful recovery. He remains in good health (June 1951); bowel function is essentially normal.

C. E., a 44-year-old male teacher, had experienced rheumatic fever with rheumatic heart disease at the age of twelve. Diarrhea first developed in 1936 and persisted for three months. A relapse occurred in 1943 and again in 1947. Treatment had included diet, sedatives, bismuth, and vitamins. The colitis recurred once more in August 1948. Proctoscopy demonstrated a granular, hyperemic, friable rectal mucosa. Improvement followed ten days of hospitalization and treatment with a bland diet, phenobarbital, and belladonna. The rectal mucosa remained granular but was no longer friable. Several mild to moderate recurrences were experienced during the first half of 1949, and the patient undertook psychiatric treatment. He spent a restful and pleasant summer in a country cottage, gained weight, and passed one or two formed bowel movements daily. The abdominal distress subsided and medication no longer was necessary. In October 1949 proctoscopy revealed an entirely normal mucosa. The patient remains in good health (June 1951) and has maintained his teaching activities.

Roentgen study in December 1948 revealed severe involvement of the entire colon. In November 1950 the colon was not as tubular as on the preceding examination; the mucosa of the ascending colon, hepatic flexure, and proximal transverse colon appeared more normal.

F. B., a 37-year-old housewife, had ulcerative colitis in 1943. The number of bowel movements increased to eighteen daily. The patient lost 20 pounds in weight. A recurrence in 1947 was complicated by arthritis of the right knee and iridocyclitis. A double-barrelled ileostomy was established elsewhere in August 1948. Symptoms persisted, however, and the patient entered the Albert Merritt Billings Hospital in December 1948. She was severely ill and undernourished. Proctoscopy revealed a diffusely inflamed, granular, and friable rectal mucosa covered with a mucopurulent exudate. The usual therapeutic measures were instituted with partial improvement clinically and proctoscopically. The iridocyclitis recurred and constituted a serious problem in therapy. The ileostomy was troublesome and the patient was unable to maintain its proper care. The ileostomy consequently was taken down and normal bowel continuity re-established. The patient remained a most difficult problem in treatment; emotional disturbances dominated the clinical picture and culminated in a frank psychosis. The loss of electrolytes via the bowel resulted in hypochloremia, hyponatremia, hypokalemia, peripheral vascular collapse, and shock; these complications were treated successfully by appropriate measures. The nursing care given by the patient's husband was of inestimable value. Definite improvement was noted in August 1949 and steadily increased. She was discharged from the hospital in October 1949 after 289 days. Her subsequent course has been surprisingly good. The number of stools diminished to five or six watery movements daily without gross blood. Menstruation returned after one year of amenorrhea. There has been a weight gain of 26 pounds. In December 1950 the rectal mucosa appeared finely granular but otherwise normal.

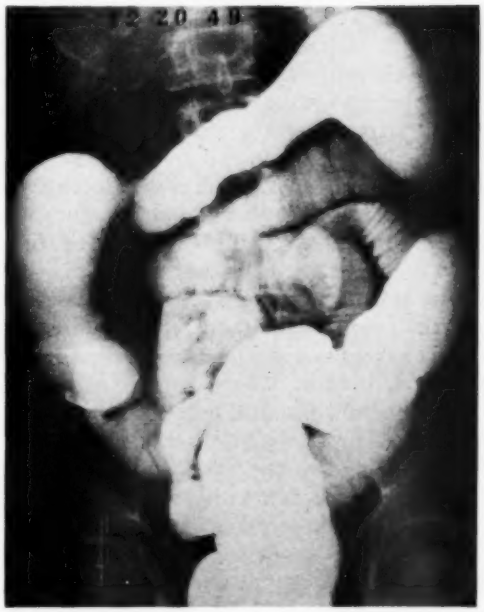

Fig. 11. M. S. Persistent roentgen evidence of severe ulcerative colitis with stenosis. Complete clinical recovery.

Roentgen examination in April 1949 revealed a narrowed, shortened colon with absence of haustral markings. In July 1949 a 1 cm. polyp on a pedicle was observed in the mid-sigmoid.

COMMENT

The healing of ulcerative colitis in this group of cases strikingly demonstrates the

reversibility of the disease. Many patients had been seriously ill, requiring frequent and prolonged hospitalization; the morphologic changes, as reflected grossly by x-ray, were extensive in most instances. Subsidence of the clinical and proctoscopic manifestations of mild ulcerative colitis is not uncommon nor unexpected. On the other hand, reversal of the contracted and rigid colon to normal, the passage of well formed bowel movements despite extensive scarring, and the disappearance of rectal strictures, as noted in two cases, seem remarkable.

The factors promoting recovery cannot be defined precisely. Greatest emphasis is to be directed to the total regimen: long-continued treatment with bed rest, sedation, restoration of nutrition, the control of infection, and psychotherapy; of these, prolonged rest and reorientation to emotional problems may have been most important. The course of events in many instances suggested that patients successfully negotiating the initial critical phases of the illness dealt with recurrences in an increasingly effective manner; perhaps "resistance" or "immunity" develops in ulcerative colitis, as in other diseases. Many more patients undoubtedly can be restored to health with earlier diagnosis and prompt, adequate treatment. ACTH may prove to be a valuable adjunct to medical therapy in promoting the healing of ulcerative colitis, as shown in patient M. S. The prompt subsidence of symptoms in an additional 30 patients thus far treated with ACTH (4) further emphasizes the reversibility of the disease.

SUMMARY

The course of ulcerative colitis is described in 24 patients, demonstrating the complete clinical reversibility of the disease and the subsidence or pronounced improvement of the roentgen manifestations. X-ray evidence of extensive ulcerative colitis disappeared completely in 6 patients. Rectal strictures were no longer demonstrable in 2 patients. The course of events in many instances indicated that patients successfully negotiating the initial critical phases of the illness subsequently dealt with recurrences in an increasingly effective manner and ultimately achieved excellent or satisfactory health.

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SUMARIO

Reversibilidad en la Colitis Ulcerada: Observaciones Clínicas y Roentgenológicas

La evolución de la colitis ulcerada, aquí descrita en 24 enfermos, demuestra la completa reversibilidad clínica de la dolencia y la atenuación o pronunciada mejoría de las manifestaciones roentgenológicas. En 6 enfermos desaparecieron absolutamente los signos roentgenológicos de colitis ulcerada extensa, y en 2 dejaron de observarse las estenosis rectales.

No cabe definir con precisión los factores que fomentan la reposición. Lo que hay que recalcar más es el régimen general: tratamiento prolongado con reposo en cama, sedación, restablecimiento de la nutrición, lucha contra la infección y psicoterapia. De estas medidas, el descanso prolongado y la reorientación hacia los problemas afectivos quizás sean las más importantes.

En muchos casos, la evolución de los acontecimientos indicó que los enfermos que bandeaban con éxito las iniciales fases críticas de la enfermedad atendían después a las recurrencias en forma cada vez más eficaz y por fin lograban excelente o satisfactoria salud.

Agenesis of the Corpus Callosum; Lipoma of the Corpus Callosum

Their Roentgen Recognition and Differentiation[1]

ARCHIE SHEINMEL, M.D.,[2] and LEWIS R. LAWRENCE, M.D.

THE DEVELOPMENTAL anomalies of the corpus callosum have only recently been described as distinct radiological entities, readily diagnosable by appropriate roentgen studies. Since the first report of the roentgenographic recognition of agenesis of the corpus callosum by Davidoff and Dyke (4) in 1934, ten reports dealing with a total of 20 instances of this type of defect have appeared in the literature. Five reports citing a total of 6 cases of lipoma of the corpus callosum diagnosed radiologically have been published, including the original mention by Dyke (5) of a case studied by Sosman. Three additional unpublished cases of the lipomatous lesion are credited to Sosman by Sutton (14). In view of the rarity of reports dealing with abnormalities of these types, it is of interest that we have encountered in the last eighteen months a strikingly representative roentgen demonstration of each of the anomalies mentioned. It is believed that these two cases are particularly instructive, since they emphasize features of salient importance from the point of view of roentgen differential diagnosis.

HISTORICAL ORIENTATION

Agenesis of the Corpus Callosum: An excellent review and bibliography of agenesis of the corpus callosum are afforded by the study of Bunts and Chaffee (3), who described the fifteenth such case diagnosed *in vivo* by encephalographic methods since Davidoff and Dyke's original description in 1934. Prior to that date, 83 cases had been collected by Baker and Graves (2), but in none of these earlier instances was the diagnosis established during life. In 1946, Echternacht and Campbell (7) were able to find 18 roentgenographically demonstrated cases in the literature and added 2 personal cases, bringing the total to 20.

The paper by Bunts and Chaffee is a detailed, well documented account of the pertinent radiological and clinical findings, and constitutes the best available source of data concerning the recognition of this entity, as well as its differentiation from other midline cerebral lesions. For that reason, we shall limit ourselves to a brief statement of the distinctive roentgen features of agenesis of the corpus callosum in the description of the case to be presented.

The etiologic factors implicated in agenesis of the corpus callosum remain entirely obscure. Indeed, the function of this structure, which represents the largest white commissure of the brain, and whose intact presence, according to Kirschbaum (9), is necessary for the normal configuration of the entire mesial surface of the brain, is unknown. In support of this fact, Bunts and Chaffee quote Dandy, Cameron and finally Bruce, who stated that if the brain is otherwise normally developed, absence of the corpus callosum does not necessarily produce any disturbance of motility, co-ordination, reflexes, speech, or intelligence.

Kirschbaum reviewed the work of Yakovlev and Wadsworth, who concluded that agenesis of the corpus callosum is caused by some unknown disturbance of growth confined to the anlage of the callosal body, resulting in the failure of development of this structure and the consequent creation of a cleft or porus. These authors employ for this type of developmental error the

[1] From the Department of Radiology, Veterans Administration Hospital, Bronx, N. Y. Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are the result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration. Accepted for publication in September 1950.

[2] Died May 2, 1950.

term "schizencephalic porencephaly" as opposed to the encephaloclastic type of porencephaly, which is attributable to circulatory or traumatic processes.

Lipoma of the Corpus Callosum: Extensive reviews of the literature on lipoma of the corpus callosum are contained in the studies by Krainer (10), and List, Holt, and Everett (11). The latter authors cited approximately 100 cases of cerebral lipomata, of which 30 were callosal in location. The first mention of the roentgen recognition of this lesion was made by Sosman, who has thus far observed a total of 4 cases. Ehni and Adson (8), List, Holt and Everett, Amyot (1), and Sutton have since reported instances of callosal lipomata diagnosed preoperatively by means of roentgen studies.[3]

Opinion regarding the pathogenesis of lipoma of the corpus callosum is divided. On the basis of his exhaustive study of 70 collected cases of cerebral lipomata, 30 of which were callosal in location, Krainer concluded that these tumors are found almost exclusively in the region of the various cisternae and choroid plexuses, and that they are due to the abnormal persistence of the embryologic or primitive meninx in these sites. Because of an error in, or arrest of, development, the primitive meninx, forerunner of the future meninges and subarachnoid spaces, fails to undergo appropriate absorption and transformation into the structures mentioned. Instead, there occurs a perversion or maldifferentiation of this abnormally persistent embryological tissue, with the ultimate appearance of fat tissue. The production, by autochthonous cellular elements, of a tissue foreign to the site of its appearance was termed "tissue malformation" by Krainer, and was considered by him to be the crucial factor in the pathogenesis of these fatty tumors. He denied the ectodermal or mesodermal origin, ectopic or heterotopic, of lipomata, as postulated by Virchow, and pointed to the invariable preservation of nervous and vascular structures in the subarachnoid spaces as proof against their neoplastic nature. He likewise negated any relationship between lipomata and epidermoid tumors as advocated by Boestrom. The size and configuration of these tumors, Krainer added, are not determined by the age of the patient, since they are all congenital, but are conditioned by the site of their appearance. Finally, this author emphasized the relationship of cerebral lipomata to the frequently associated congenital abnormalities of the neighboring structures, including complete or partial agenesis of the corpus callosum and incomplete evolution of the falx and the surrounding meninges.

In regard to the lipomata of the corpus callosum specifically, Krainer stated that most of these tumors are veritable casts of the cisterna corporis callosi, and consequently their configuration tends to reproduce the contours of these subarachnoid spaces, although the lipomata usually enlarge and may distort the actual outlines. He defined the cisterna corporis callosi as a simple arachnoid space above the corpus callosum, communicating anteriorly with the lamina terminalis in the region of the genu, and with the cisterna ambiens and cisterna of the velum triangulare caudally, in the region of the splenium. Laterally, the cisterna continues into the depths of the sulcus corporis callosi. Superiorly, the cisterna merges gradually with the network of the subarachnoid spaces on both sides of the falx.

Ehni and Adson offered other explanations for the causation of cerebral lipomata, such as abnormal proliferation of the normally few fat cells contained in the leptomeninges, and/or the abnormal inclusion of fat-forming material within the closing lips of the neural groove. List, Holt and Everett were among the first to use the term "dysraphic state," which they applied to a malclosure of the neuraxis resulting in disturbances of growth of scattered midline structures, such as the corpus callosum, sternum, lumbosacral spine, etc. Among the specific skeletal anomalies encountered

[3] A further report appeared after acceptance of this paper for publication (Mullen, W. H., and Hannan, J. R.: Radiology 55: 598, October 1950).

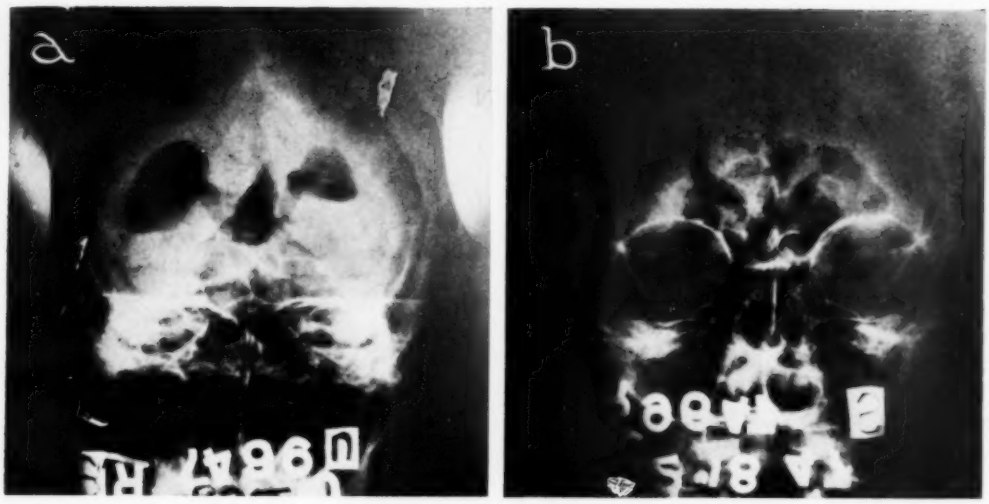


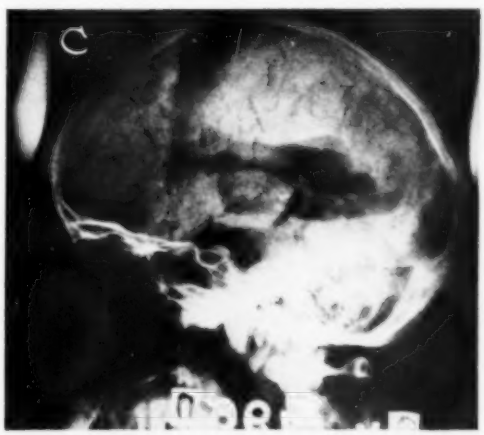
Fig. 1. Pneumoencephalographic studies: agenesis of the corpus callosum

a. Postero-anterior sagittal projection, revealing a marked degree of separation of the lateral ventricles, dilatation, ascent of the third ventricle, and striking elongation, widening, and elevation of the interventricular foramina. The resultant distinctive "batwing" configuration is evident. The dilatation of the posterior segments of the lateral ventricles is likewise readily apparent.

b. Anteroposterior sagittal projection, confirming the marked degree of separation of the lateral ventricles, and demonstrating the slightly concave mesial aspect of the lateral ventricle. The peaked appearance of the dorsal margins of the ventricle is evident.

by Krainer and List *et al.* may be mentioned persistence of the midfrontal suture, lumbosacral spina bifida, myelomeningocele, and funnel chest.

The association of lipoma of the corpus callosum with defective development of this structure, resulting in agenesis of degrees varying from partial to complete, has received considerable attention. Krainer collected 4 cases of lipoma of the corpus callosum in which there were noted varying degrees of hypoplasia of the callosal structure, and 2 cases in which the degree of agenesis was sufficiently marked to provoke speculation regarding the sequential and/or causal relationship, if any, existing between the two defects. Additional instances of partial agenesis associated with callosal lipoma have been cited by Ehni and Adson, List *et al.*, and Amyot. Sutton quoted a personal communication from Sosman, who stated that all of his cases of lipoma of the corpus callosum were associated with agenesis of this commissure. Krainer felt that the presence of the lipoma occasionally prevented proper development of the commissure and hence was the primary lesion. List *et al.* are in agreement with this belief, but caution against the assumption that the two lesions are always coexistent. In support of this contention, they cite the experience of Bunts and Chaffee, who were unable to find any mention



c. Right lateral projection, emphasizing the encroachment on the bodies of the lateral ventricle by the elevated third ventricle. The dilatation of the posterior segments of the lateral ventricles is again noted.

of an associated lipoma in the 5 operatively proved cases of agenesis of the corpus callosum in their series of 15.

It appears warranted to differentiate those cases of agenesis of the corpus callosum which are primary, and developmentally and anatomically unrelated to any fortuitously associated defects, from those in which the agenesis is secondary to the presence of a lipomatous mass which prevents proper development of the commissure. This differentiation would adequately explain the negative results of Bunts and Chaffee, who sought to find instances of lipoma of the corpus callosum in cases of primary agenesis, and the correspondingly large number of cases of proved concomitance of lesions cited by reporters of lipomatous defects of the commissure.

CASE REPORTS

AGENESIS OF THE CORPUS CALLOSUM: A 24-year-old white male was admitted in early 1947 with a history of recurring epileptiform seizures since 1942. The typical attack, of which the patient recalled five instances since the onset of illness, consisted of flexion of the right forearm on the right upper arm, rotation of the head to the left, and repeated "kicking" of both legs. In each instance, the episode was preceded by an aura of warmth, tension in the abdomen, and a feeling of apprehension.

The antecedent personal and familial histories were not contributory. Physical examination revealed no abnormality. A psychiatric survey disclosed an individual of generally decreased affect and subnormal intelligence, who appeared completely unconcerned with his difficulties.

The preliminary roentgen examination of the skull was interpreted as normal. Because of the history, pneumoencephalographic study was deemed advisable and was performed. The postero-anterior sagittal projection (Fig. 1, a) revealed a marked degree of separation of the lateral ventricles. The third ventricle appeared enlarged and displaced dorsally, and the interventricular foramina were strikingly prominent, elongated, widened, and elevated. The posterior segments of the lateral ventricles were dilated bilaterally. The anteroposterior sagittal study (Fig. 1, b) confirmed the marked degree of separation of the lateral ventricles and demonstrated a slight concave indentation of their mesial borders. The anterior segments of the lateral ventricles appeared especially displaced and distorted, and their dorsal and medial aspects assumed a narrow, peaked appearance. The lateral study of the skull (Fig. 1, c) demonstrated the dorsal displacement of the third ventricle, the dilatation of the posterior portions of the lateral ventricles, and the shallowness of the anterior segments of the lateral ventricles. These findings were considered pathognomonic of agenesis of the corpus callosum.

The roentgen appearances described in this case closely parallel the classical pattern originally noted by Davidoff and Dyke, and subsequently reviewed by Bunts and Chaffee. Of the seven cardinal features stressed, namely, (*a*) marked separation of the lateral ventricles, (*b*) angular dorsal margins of the lateral ventricles, (*c*) concave mesial borders, (*d*) dilatation of the caudal portions of the lateral ventricles, (*e*) elongation of the interventricular foramina, (*f*) dorsal extension and dilatation of the third ventricle, and (g) radial arrangement of the mesial cerebral sulci around the roof of the third ventricle and their extension through the zone normally occupied by the corpus callosum, all except the last are clearly illustrated by this case.

The clinical findings include the two most frequent manifestations set forth by Bunts and Chaffee, subnormal intelligence and convulsive seizures, which have neither a definite pattern nor localizing value. Other less constant signs include spastic paraplegia, hyperreflexia, athetoid movements, and the Babinski sign.

LIPOMA OF THE CORPUS CALLOSUM: A 20-year-old white male entered the hospital because of periodic episodes of loss of consciousness and "convulsions." His past history was not revealing. In February 1946, the patient "fell out of bed" while asleep in an army barracks. He was helped back by his bunkmates. A month later, he suffered a similar accident, but this time he was "slugged" by a soldier who thought he was "mad." There was complete amnesia for this event, except for a feeling of "soreness all over the body" the next day.

Later in 1946 there occurred the first of a series of "spells" which were characterized by an imperious desire to run and to urinate, and which ended with the patient awakening with a spoon thrust between his teeth. These attacks recurred at irregular intervals. Occasionally, the symptoms were reduced to an irresistible desire to urinate, after which the attack was aborted. There had been no known "spells" since the latter half of 1946.

Positive physical findings included a spina bifida, a positive finger stretch, and a slightly increased right ankle jerk. No other clinical stigmata were

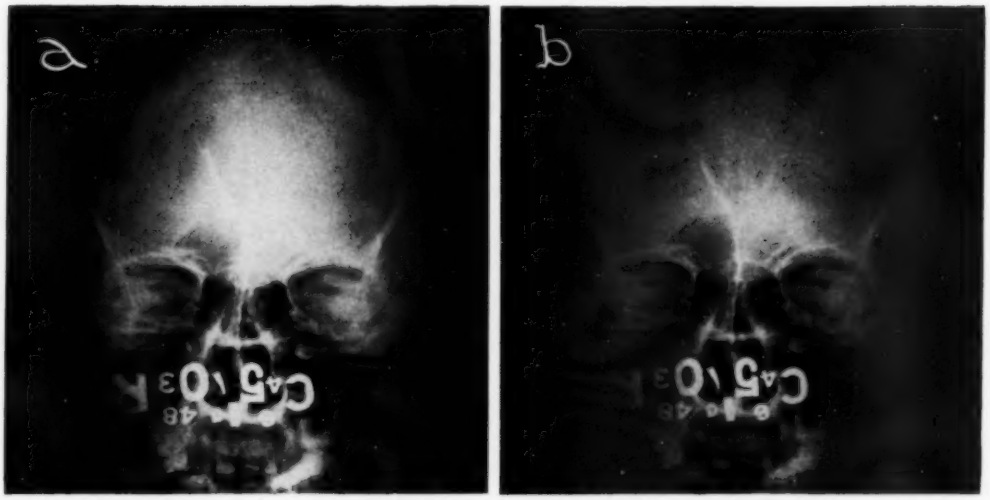


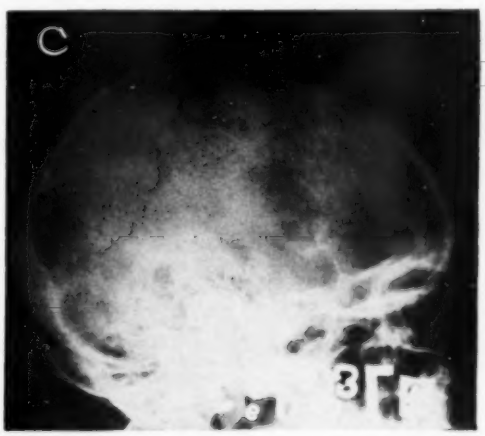
Fig. 2. Preliminary studies of the skull: lipoma of the corpus callosum.
a. Postero-anterior projection, revealing the linear oblique bands of calcification which converge toward the midline. No other abnormalities are observed.
b. Unretouched, but over-developed print of a. to emphasize the linear calcifications.

present. A spinal fluid examination was negative. The electroencephalogram showed abnormalities in all areas, more marked on the right. The over-all pattern was consistent with cortical atrophy or a convulsive disorder. A psychometric study showed the patient to have a bright basic intelligence, but to be immature in psychosexual development, and obviously passive and dependent.

Preliminary examination of the skull demonstrated bilateral linear calcifications in the sagittal plane (Fig. 2, a). These concretions were symmetrically disposed relative to the midline and, from a point equidistant from the inner table of the skull and the midpoint of the superior rim of the corresponding orbit, were directed downward and mesially, terminating at the superior border of the respective frontal sinus, without joining. Figure 2, b is an overdeveloped reproduction to delineate more clearly the linear bands of calcification.

A lateral exposure of the skull (Fig. 2, c) revealed a singularly apparent, somewhat irregularly ovoid zone of radiolucency, measuring approximately 5 cm. in its greatest diameter, located in the inferior aspect of the frontoparietal area. The anterosuperior border of this radiolucent image was well demarcated by the profile projection of the above described calcifications. The resemblance of the resultant configuration to the rostral aspect of the corpus callosum, considerably enlarged, was unmistakable. This impression was corroborated by stereoscopy.

Air studies disclosed marked separation of the anterior segments of the lateral ventricles by a space-occupying midline lesion best demonstrated in the upright sagittal (Fig. 3, a), postero-anterior sagittal



c. Lateral study of the skull, outlining a definite ovoid zone of radiolucency. The border-forming curvilinear calcified deposits anteriorly and inferiorly are likewise apparent.

(Fig. 3, b) and Towne's (Fig. 3, c) projections. The peripheral limits of this mass were fixed by the presence of the border-forming calcifications discussed. The third ventricle, normal in size, was moderately elevated. The posterior portions of the lateral ventricles were considerably dilated.

Lateral views of the skull, including an erect right (Fig. 3, d) and a left horizontal lateral (Fig. 3, e), demonstrated the deformity of the anterior aspects of the lateral ventricles due to the impinging presence of the radiolucent defect. The third ventricle

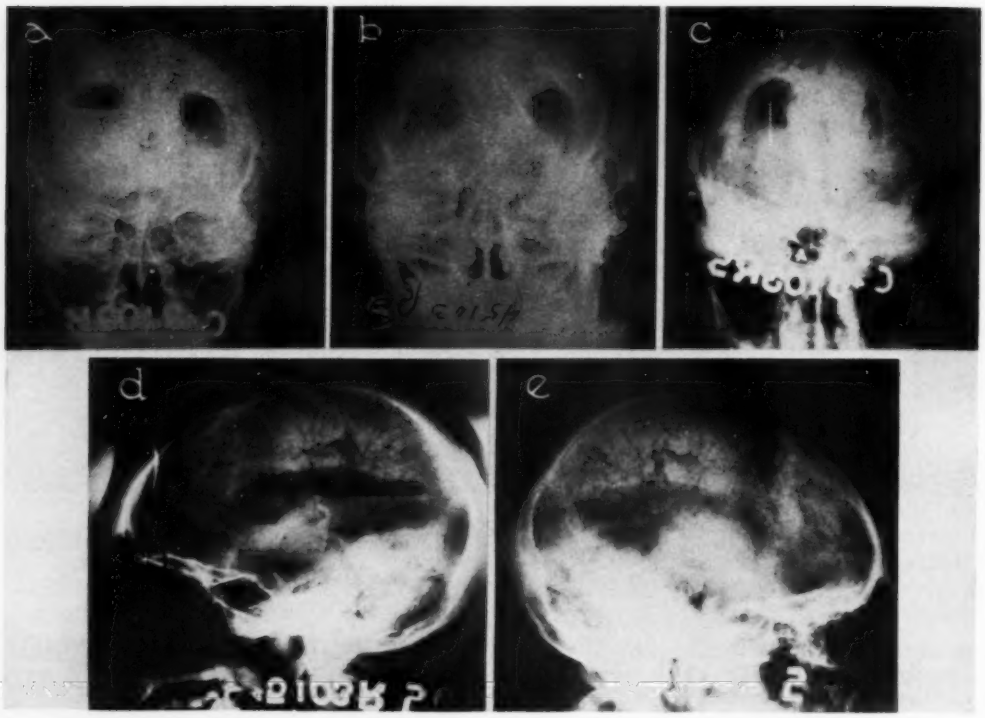


Fig. 3. Pneumoencephalographic studies: lipoma of the corpus callosum

a. Erect postero-anterior sagittal study, demonstrating the separation of the lateral ventricles and the slight elevation of the third ventricle, which is normal in size. The calcifications are too faintly visualized in this reproduction (see explanatory line drawing—Fig. 4, a—traced from the roentgenogram). The dilatation of the posterior segments of the lateral ventricles is apparent.

b. Prone postero-anterior sagittal projection, confirming the separation of the anterior segments of the lateral ventricles and the dilatation of the posterior portion. The calcifications are not clearly discernible.

c. Towne's projection, demonstrating the separation of the anterior segments of the lateral ventricles. The dilatation of the rostral aspects of the lateral ventricles and the normally contoured temporal horns. Calcifications are not too clearly observed on this reproduction, and the third ventricle is not discernible.

d. Erect right lateral exposure, showing the impingement of the ovoid radiolucent defect upon the anterior horns of the lateral ventricles. The curvilinear border-forming calcifications are noted at the anterior aspect of the lipoma—see Fig. 4, d for explanatory line drawing traced from the roentgenogram.

e. Horizontal left lateral study included to illustrate the shallowness of the anterior aspects of the lateral ventricles and the dilatation of the posterior portions.

was clearly delineated on the erect lateral study (Fig. 3, d) and its elevation confirmed. The dilatation of the posterior segments of the lateral ventricles was similarly corroborated. Stereoscopically, the displacement and distortion of the anterior segments of the lateral ventricles by the intruding midline mass were emphasized. Because of the unusual calcifications, the ovoid radiolucent defect, and the gross disturbance in ventricular outline, the diagnosis of lipoma of the corpus callosum was made. That there was an associated degree of agenesis was demonstrated by the cephalic displacement of the third ventricle.

The displacement of the third ventricle observed in this case was also noted in the cases reported by List *et al.* and Sutton. It is therefore apparent that the third ventricle need not be depressed in lipoma of the corpus callosum, as originally described by Dyke, but may actually be elevated, if there is a concomitant partial callosal agenesis.

The clinical manifestations here, too, are not distinctive nor localizing. Non-specific convulsive episodes are most frequent. Mental changes are next most common, though, as in this instance, the intelligence is frequently unimpaired.

ROENTGEN DIFFERENTIAL DIAGNOSIS

The most frequent midline cerebral lesions which must be considered in an adequate roentgen differentiation of causes of symmetrical distortion and/or separation of the rostral portions of the lateral ventricles are agenesis of the corpus callosum, tumors of the corpus callosum, and congenital cysts of the cavum septi pellucidi. Other midline lesions enumerated by Echternacht and Campbell and by Lowman *et. al.* (12) are solid tumors of the septum pellucidum, tumors arising from the mesial wall of the lateral ventricles, midline frontal lobe tumors, lesions of the third ventricle, pinealomas, and meningiomas, either basilar or parasagittal. With the exception of the first named, these latter entities usually lack completely the symmetrical and smooth displacement of the anterior portions of the lateral ventricles so distinctive of the conditions under discussion, and hence can readily be excluded. According to Pancoast, Pendergrass, and Schaeffer (13), the rare solid tumors of the septum pellucidum produce irregular and asymmetrical distortion of the contours of this structure, although the case cited by Lowman *et al.* is an exception.

The preliminary studies of the skull are of paramount importance, since the radiolucency described above, as well as the unmistakable bilateral calcifications, are pathognomonic of lipoma of the corpus callosum and further studies are merely confirmatory. Roentgenograms of good quality are indispensable, since the slightest technical imperfections may obscure vital detail. Although other tumors of the corpus callosum may occasionally calcify, notably astrocytomas and oligodendrogliomas, the concretions are amorphous and scattered and never present the continuity and symmetrical configuration illustrated in all of the published reports of lipoma of the corpus callosum. In no other intracranial lesion, with the exception of encephalotrigeminal angiomatosis, is the preliminary study of the skull of such instantaneous diagnostic value. Further, in cases of

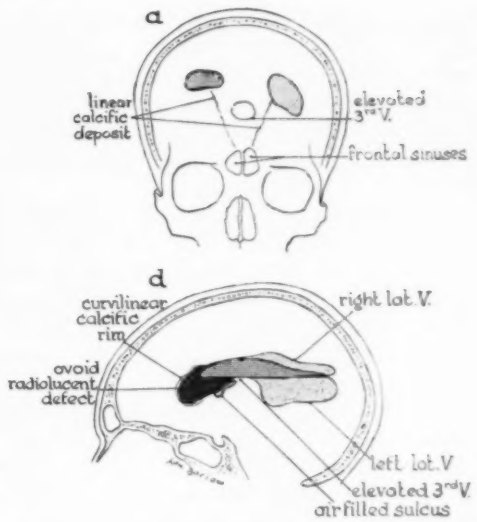


Fig. 4. a. Reproduction of tracing of roentgenogram shown in Fig. 3, a.
d. Reproduction of tracing of roentgenogram shown in Fig. 3, d.

callosal tumors other than lipomata, the encephalographic findings, as described by Dyke and Davidoff (6), are again those of an irregular and asymmetrical mass causing uneven distortion of the ventricles, with predominant involvement of their dorsal aspect, either unilateral or bilateral.

Frequent reference has been made in the literature to the similarity of the encephalographic pattern resulting from cerebral air studies in lipoma and agenesis of the corpus callosum. However, despite the striking degree of separation, indentation, and deformity of the anterior segments of the lateral ventricles in both entities, the distinguishing features are nevertheless prominent, chiefly by virtue of the unique details noted in agenesis. The single most important differentiating point in favor of agenesis is the position of the dilated third ventricle. In 12 of the 14 cases for which cerebral air studies were diagrammatically reproduced by Bunts and Chaffee, this ventricle was impressively elevated to a degree not observed in instances of lipoma of the corpus callosum. The striking elongation and prominence of the interventricular foramina and the peaked or angular

dorsal margins of the lateral ventricles are additional diagnostic features. When these defects are noted concomitantly, the resulting "bat-wing" configuration is pathognomonic of agenesis. Seven of the series studied by Bunts and Chaffee presented this unusually distinctive pattern.

In regard to the congenital cysts of the cavum septi pellucidi, one must distinguish between the communicating and non-communicating types. In the former entity, the sagittal projection demonstrates a separation of the anterior segments of the lateral ventricles which is readily discernible but considerably less striking than the degree of deformity noted in the callosal lesions. More obvious, however, is the presence of air in the dilated cavum septi pellucidi, which is again pathognomonic. There is no significant indentation of the medial aspects of the lateral ventricles, and the position of the third ventricle, as well as the appearance of the interventricular foramina, is not noteworthy. The lateral exposures reveal a comma-shaped area of radiolucency, with its greatest diameter directed anteriorly, superimposed on the anterior segments of the lateral ventricles. This radiolucent zone may be hour-glass in configuration if there is communication with a coexisting cyst of the cavum vergae.

In instances of the considerably rarer non-communicating cysts of the cavum septi pellucidi, the anterior horns may or may not be separated, and there is again little deformity or indentation of the mesial aspects of the lateral ventricles. In the lateral studies, the presence of a comma-shaped density, whose configuration conforms to the radiolucent defect just mentioned, is diagnostic.

STATISTICAL EVALUATION OF THE VARIABILITY OF THE ROENTGEN APPEARANCE OF LIPOMATA OF THE CORPUS CALLOSUM AND ITS POSSIBLE SIGNIFICANCE

The size and configuration of callosal lipomata vary considerably. For the most part, the descriptive data available for review are incomplete. Nevertheless, from an analysis of the 30 tabulated cases supplied by List *et al.*, in addition to the cases reported by Amyot and Sutton, it may be assumed that 12 of the reported lipomata, where dimensions are grossly indicated either by an estimate of the extent of corpus callosum involved or replaced, or by a descriptive comparison, such as walnut or plum-sized, were of considerable magnitude. Fifteen other lesions were described as flat, pea-sized or streak-like, and were of distinctly lesser size. Of the 12 larger lesions, 6 were reported as containing calcification and were accompanied by mental and/or neurological changes. Two additional cases from the larger group contained calcification but were symptomless, and finally, 2 other cases were associated with symptoms but presented no calcifications. Of the 7 cases now published, including the present instance, in which *intra vitam* roentgen studies were accomplished, all were accompanied by symptoms and all presented calcifications.

Of the 15 smaller lesions, only one case presented symptoms and calcification; one other showed evidence of calcification but exhibited no symptoms, and lastly, one case showed signs of mental changes without evidence of calcification.

It is therefore quite evident that the larger lipomata are far more likely to contain calcification and be accompanied by mental and/or neurological changes. Of considerably greater interest, however, is the fact that all published instances of lipomata of the corpus callosum roentgenographically studied to date exhibit a uniformity of appearance in regard to both their configuration, rendered evident by virtue of their radiability, and the disposition of their contained calcific deposits. It would therefore appear logical to postulate that these larger lipomata have attained their fullest potentiality of space occupation, which is limited by the physical presence of surrounding structures. This hypothesis would tend to confirm the concept of Krainer, who believed that all cerebral lipomata arise in the cisternae, which though frequently grossly distended nev-

ertheless serve as a confining mold for these tumors. Krainer cited the instance of a lipoma whose configuration was a virtual cast of the cisterna pontis, and another which reproduced the outlines of the cisterna fossae sylvii. An additional point in favor of the cisternal origin of these lipomata is the constancy with which the anterior cerebral arteries are inextricably enmeshed with the lipomatous tissue, rather than being deflected or deviated, as one might expect if the tumor were extracisternal in origin. A final anatomic finding in support of this contention is the constant dorsal situation of lipomata of the corpus callosum, a feature stressed by List *et al.*, who stated that "a lipoma of the corpus callosum is always situated on the dorsal surface and closely follows the contours of that structure."

CONCLUSION

The diagnostic features of the cases of agenesis and lipoma of the corpus callosum presented are of sufficient interest to merit attention despite the fact that no actual anatomic confirmation is available. Sufficient criteria now exist to assure roentgen differentiation of the various midline cerebral anomalies. However, of all these, lipoma of the corpus callosum alone lends itself to immediate diagnosis on the basis of preliminary studies of the skull. The uniformly poor results attendant upon surgical intervention in cases of lipoma of the corpus callosum have been stressed by Ehni and Adson, List *et al.*, Amyot, and Sutton. The chief reason for the inoperability of this lesion is the inseparability of vascular elements of the anterior cerebral arteries and the lipomatous tissue.

SUMMARY

1. The historical background and possible etiologic factors in the causation of agenesis and lipoma of the corpus callosum have been discussed, and two cases illustrating the salient features of each of the two anomalies have been presented.

2. The midline cerebral anomalies have been briefly reviewed and their diagnostic criteria discussed.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

Agenesia del Cuerpo Calloso; Lipoma del Cuerpo Calloso: Reconocimiento y Diferenciación Roentgenológicos

De los dos casos comunicados, uno era de agenesia, y el otro de lipoma, del cuerpo calloso.

El caso de agenesia presentó los siguientes hallazgos roentgenológicos ya descritos por otros observadores: pronunciada separación de los ventrículos laterales, angulación de los bordes dorsales de los ventrículos laterales, concavidad de los bordes mesiales, dilatación de las porciones caudales de los ventrículos laterales, alargamiento de los agujeros interventriculares y extensión y dilatación dorsal del tercer ventrículo.

Los hallazgos en el lipoma fueron patognomónicos, a saber: zona irregularmente ovoidea de radiolucencia en la cara inferior de la zona frontoparietal, trastorno macroscópico del contorno de los ventrículos laterales y calcificaciones lineales bilaterales.

El patrón encefalográfico en los dos estados es semejante en cuanto al notable grado de separación, indentación y deformidad de los segmentos anteriores de los ventrículos laterales. El punto más importante de diferenciación en pro de la agenesia es la posición del dilatado tercer ventrículo, el cual se halla notablemente elevado en la mayor parte de los casos. El alargamiento y prominencia de los agujeros interventriculares y la angulación o aguzamiento de los bordes dorsales de los ventrículos laterales constituyen otras características diagnósticas. Cuando se notan esas deformaciones conjuntamente, la resultante configuración en "ala de murciélago" es diacrítica de agenesia.

También hay que diferenciar de la agenesia y del lipoma del cuerpo calloso los tumores de la línea media y los quistes congénitos del quinto ventrículo (cavidad del tabique pelúcido).

Roentgen Therapy of Primary Neoplasms of the Brain[1]

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SURGERY is the treatment of choice for most primary neoplasms of the brain. However, the extent of surgical intervention varies. Many growths are inaccessible and a decompression is the sole procedure possible. In some instances, the surgeon can do only a partial resection or remove some tissue for biopsy. Complete enucleation is rarely accomplished in certain of the gliomas, particularly glioblastoma multiforme. Where surgery is incomplete, radiotherapy is given in the hope that it will benefit the patient. The method of irradiation and what constitutes adequate dosage are still unsolved problems. The most prevalent roentgen technic is the single protracted series of high-voltage treatments, directed through multiple portals for tumor doses of approximately 5,000 r. Peirce and his collaborators (1) commonly administer a total dose of 10,000 to 15,000 r in air in a single course, at 50 cm. target-skin distance, h.v.l. 2.0 mm. Cu. The tumor dose has been calculated by them to be about 90 per cent of the total roentgens in air for frontal lobe lesions, 83 per cent in the temporal and parietal group, and 72 per cent in the occipital. Dyke and Davidoff (2), and others, have given several shorter series, with doses of 1,000 r in air to each of three to four portals for each course.

It is well known that for most gliomas the mortality is high in the first year after the diagnosis has been made and following surgical intervention, with or without irradiation postoperatively. This being so, can we assume that the life of the remaining patients has been extended by irradiation with increased dosage (1)? Or may it be that those surviving the first year have tumors that are of a less fulminating type and that the subsequent course, with the control of symptoms afforded by irradiation, may perhaps be achieved equally well with a single protracted course of radiotherapy or multiple shorter series?

The histopathological changes seen in some gliomas following irradiation are ascribed principally to the roentgen therapy (3, 4). The degree of the changes produced, however, is not proportional to the amount of radiation given (3), and they are themselves hard to evaluate. In tumors in other parts of the body, they would be called irradiation effects. In gliomas, they may occur without irradiation.

It may be that additional secondary effects on the tumor behavior are produced by blood vessel alterations for which intensive therapy is not necessary. It is also possible that clinical improvement results from growth restraint as much as from massive tumor destruction. This may explain the good response obtained in many instances by the multiple series technic. Obviously, research must continue until a more satisfactory irradiation method has been demonstrated.

AUTHORS' MATERIAL

The purpose of this report is to relate our experiences with the postoperative roentgen treatment of brain tumors, principally in a single protracted course, but including some cases receiving multiple short series. Reference will also be made to the reaction of a few of the glioblastoma multiforme patients to nitrogen mustard. For purposes of comparison, the presentation of this material will closely parallel that employed by Dyke and Davidoff (2). Only those cases are included which had re-

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ceived adequate irradiation and which were histologically verified.

In many cases postmortem examinations were done and the material was examined for post-irradiation effects. As pointed out above, radiation changes in brain tumors are difficult to evaluate. Necrosis, areas of calcification, atypical giant cells, fibroblasts, hyalinization in the walls of blood vessels, all may occur in gliomas not previously irradiated. Yet these changes in irradiated tumors other than those of the central nervous system are indicative of radiation effects. There is little doubt that some of the reports in the literature on post-irradiation changes in brain tumors have been erroneously interpreted. The minimum requirements for a study of such changes would be pre-irradiation biopsy and biopsy at certain fixed periods following irradiation. To meet such requirements is difficult. Moreover, a biopsy specimen from one area of a large tumor does not necessarily represent the histology of the whole growth. In this report, the postmortem observations will be used only to verify the histologic diagnosis.

Tables have been prepared listing the age, type of operation, details of radiotherapy and postoperative survival in the cases investigated, but it is difficult within the limits of a table to include all the details of irradiation. With few exceptions, the voltage used was either 200 or 400 kv. In some instances, however, in other institutions, irradiation at 180, 185 or 190 kv. was utilized. Filtration for the voltages up to 200 kv.was in general 1 mm. Cu plus 1 mm. Al, h.v.l. 1.5 mm. Cu; occasionally 2 mm. Cu plus 1 mm. Al, h.v.l. 2 mm. Cu, and 0.5 mm. Cu plus 1 mm. Al, h.v.l. 1 mm. Cu. Target-skin distance for the 200-kv. range was 50 cm., with one exception, when it was 40 cm. For the 400-kv. radiation the filter was 4 mm. Cu plus 1 mm. Al, h.v.l. 4 mm. Cu, target-skin distance 70 cm.

Three portals were commonly utilized. The fields for frontal and temporal lesions were lateral, vertex, and frontal; occasionally a contralateral field was used. For parietal lesions the portals were the same except that the frontal was omitted and an occipital added. Occipital lobe tumors were irradiated through lateral portals and a posterior occipital port. The size of the fields varied from 6 × 8 cm. for the frontal ports to 8 × 10 cm. or 8 × 12 cm. for the vertex and occiput, and 10 × 10 cm. to 10 × 15 cm. for the lateral fields. The patients were treated daily if their condition permitted; otherwise every other day. The daily skin dose ranged between 150 and 250 r; usually it was 200 r. In the tables, and also in the various case reports, treatment in the 200-kv. range will be referred to as Technic 1, and that with 400 kv. as Technic 2.

GLIOBLASTOMA MULTIFORME

Thirty patients with glioblastoma multiforme were available for study, 18 males and 12 females. The ages varied from nineteen to sixty-five, the average being 45.3 years. The average survival period after operation for the entire group was 14.9 months. If we exclude the longest survival, 9 years and 9 months, the average for the other twenty-nine patients is 11.4 months, as compared with Dyke and Davidoff's figure of 11.5 months. Individual survival periods ranged from 2 months to 9 years and 9 months (Dyke and Davidoff between 2 and 46 months).

Table I lists the postoperative survival period against the total radiation in roentgens. Seventeen patients survived less than 10 months. For these, the maximum skin dosage was 21,000 r, the minimum 2,500 r, with the majority receiving over 8,000 r. Nine patients survived between 10 and 20 months. The largest dose (to the skin with scatter) in this group was 19,600 r, the smallest 3,075 r. A third group consisted of 4 patients, with survivals of beyond 20 months. One received 18,068 r and survived 9 years and 9 months, though most of the improvement followed a dose of only 6,068 r. Another patient ran a most unusual course. He was given 9,500 r three months following the onset of symptoms and remained well for 4 years.

TABLE I: GLIOBLASTOMA MULTIFORME. RELATION OF SURVIVAL PERIOD TO DOSAGE

Montefiore Hospital Number	Age at Operation	Operation	No. of Courses and Technic of Irradiation*	Roentgens to Scalp	Tumor Dose (r)	Post-operative Survival
32906	42	Biopsy	2 (1 with 1, 1 with 2)	18,068	11,961	9 yr. 9 mo.
41109	42	Decompression. Later partial removal	2 with 1	11,300	6,046	3 yr. 9 mo. (8 yr. 4 mo. since symptoms)
45065	38	Subtotal removal	2 with 1	5,200	2,444	3 yr. 4 mo.
28799	30	Partial removal	1 with 1	11,600	7,040	2 yr. 10 mo.
37686	56	Partial removal	1 with 1	17,500	8,760	1 yr. 5 mo.
35084	47	Biopsy	2 with 1	16,250	9,910	1 yr. 4 mo.
40036	50	Subtotal removal	2 with 1	6,000	3,620	1 yr. 3 mo.
43617	48	Partial removal	1 with 1	10,700	5,033	1 yr.
30087	24	Biopsy	2 with 1	19,600	8,620	1 yr.
41435	39	Subtotal removal	1 with 1	3,075	1,106	1 yr.
38495	48	Subtotal removal	2 with 1	6,000	4,220	1 yr.
37963	53	Biopsy	2 with 1	13,800	7,600	10 mo.
38294	19	Biopsy	2 (1 with 1, 1 with 2)	13,000	7,795	10 mo.
41800	51	Biopsy	2 with 1	7,175	4,357	9 mo.
23429	28	Partial removal	1 with 1	8,750	4,770	9 mo.
44271	45	Subtotal removal	2 (1 with 1, 1 with 2)	10,200	5,375	8 mo.
31716	48	Subtotal removal	3 with 1	8,800	4,847	7 mo.
44132	56	Partial removal	1 with 1	4,450	2,623	7 mo.
24359	50	Partial removal	1 with 1	9,000	4,500	7 mo.
41877	65	Complete removal	1 with 2	4,600	2,022	6 mo.
33681	54	Biopsy	1 with 1	9,000	4,740	6 mo.
41328	60	Biopsy	1 with 2	8,800	5,610	6 mo.
24244	37	Partial removal	1 with 1	21,000	9,870	6 mo.
24713	52	Partial removal	2 with 1	7,875	4,150	5.5 mo.
42831	58	Complete removal	1 with 1	15,100	5,175	4 mo.
41229	31	Subtotal removal	1 with 1	10,450	4,600	4 mo.
28051	58	Biopsy	1 with 1	2,500	1,890	4 mo.
41754	31	Biopsy	1 with 1	5,750	3,730	3 mo.
18633	50	Biopsy	2 with 1	7,500	3,365	3 mo.
36129	50	Partial removal	1 with 1	6,300	3,440	2 mo.

* Technic 1 = 200 kv. Technic 2 = 400 kv. See text for details.

Symptoms then recurred and a decompression was done followed by further irradiation (1,800 r). He was again operated upon a year later and a glioblastoma multiforme was partially removed. He is bedridden, with a hemiplegia, but still living in June 1950, 3 years and 9 months following the first operation and 8 years and 4 months following the onset of symptoms. A third patient received 5,200 r and survived 3 years and 4 months postoperatively, with most of the improvement following a dose of 2,800 r. The fourth patient was given 11,600 r and survived 2 years and 10 months after operation.

Although the average survival following operation for our group (with the exception of the long-lived patient previously noted) closely approximates that of Dyke and Davidoff, our conclusions as to optimum dosage do not correspond (Table I). In the Dyke and Davidoff series, the optimum dose was between 5,000 and 10,000 r. Less than 5,000 r appeared to be inadequate. Our 4 longest surviving patients did very well with initial doses of 6,068 r, 9,500 r, 2,800 r, and 11,600 r. When recurrences developed in 3 of these patients, 2 were improved for a time by additional irradiation; the third did not respond and

TABLE II: GLIOBLASTOMA MULTIFORME. POSTOPERATIVE SURVIVAL ON BASIS OF ONE OR MORE COURSES OF LOW INTENSITY OR ONE INTENSIVE COURSE

One or More Courses of Low Intensity			One Intensive Course		
Montefiore Hosp. No.	Roentgens to Scalp	Postoperative Survival	Montefiore Hosp. No.	Roentgens to Scalp	Postoperative Survival
45065	5,200	3 yr. 4 mo.	32906	18,068	9 yr. 9 mo.
40036	6,000	15 mo.	41109	11,300	3 yr. 9 mo.
41435	3,075	12 mo.	28799	11,600	2 yr. 10 mo.
38495	6,000	12 mo.	37686	17,500	1 yr. 5 mo.
41800	7,175	9 mo.	35084	16,250	1 yr. 4 mo.
31716	8,800	7 mo.	43617	10,700	1 yr.
44132	4,450	7 mo.	30087	19,600	1 yr.
24359	9,000	7 mo.	37963	13,800	10 mo.
41877	4,500	6 mo.	38294	13,000	10 mo.
28051	2,500	4 mo.	23429	8,750	9 mo.
18633	7,500	3 mo.	44271	10,200	8 mo.
			33681	9,000	6 mo.
			41328	8,800	6 mo.
			24244	21,000	6 mo.
			24713	7,875	5.5 mo.
			42831	15,100	4 mo.
			41229	10,450	4 mo.
			41754	5,750	3 mo.
			36129	6,100	2 mo.

died. The remaining 26 patients did badly, irrespective of dosage. It appears that for this group, length of survival was not related to high dosage.

We next tried to determine if survival were influenced by the mode of irradiation, that is, one moderately intense series of treatments, with skin doses usually in excess of 10,000 r, as compared to several courses (usually three), each totaling about 3,000 r, at monthly intervals. Excluding the patient with the very long survival from the calculations, 18 patients were available who could be classified as receiving one intense course of treatment, and 11 who were treated with one or more courses for a total of about 3,000 r to several portals, per course (Table II). Some of the patients included as receiving one intensive course received additional radiation terminally because of recurrence of symptoms. The average postoperative survival of the group receiving one intensive course was 11.6 months, as against 11 months for the multiple short series group and 11.6 months for the group of Dyke and Davidoff also treated with multiple courses. It is obvious that no appreciable difference in survival time exists for these three groups.

Comparison was also made of the type of operation with the survival period. In 21 patients, either a biopsy or a partial removal was performed, while the other 9 had a subtotal or complete removal. As in Dyke and Davidoff's series, the survival period (if we exclude the patient who survived nine years and nine months) was approximately the same for both operations: 10.8 months for biopsy or partial removal, 12 months for subtotal or complete removal.

Nitrogen Mustard: Several years ago, when nitrogen mustard became available and was shown to have a selective destructive action in certain neoplastic diseases, it was decided to test the effect of this drug on a few cases of glioblastoma multiforme. Four patients were treated. One was given roentgen therapy postoperatively and, when she continued going down hill, received a course of nitrogen mustard, at the same time continuing with the irradiation. She did badly and died about a month later. Another patient was given nitrogen mustard postoperatively and, when he failed to respond, was

started on roentgen therapy without altering the progress of the disease. The third patient received nitrogen mustard and no radiation and she also did poorly. In a fourth case two courses of nitrogen mustard were given with an interval of one month between courses. This was followed by intensive roentgen therapy. The patient did not improve and died five months later.

To sum up our experiences with the glioblastoma multiforme group, survival was not influenced by the type of operation, by the amount or method of postoperative irradiation, or by nitrogen mustard. The following case is cited in detail because it is a good example of lengthy survival and also demonstrates the slow growth of some of these tumors.

CASE 1.[3] S. S. (Montefiore Hospital No. 32906), male, aged 52 years. On Oct. 13, 1933, at the age of 42, this patient was admitted to the University of Chicago Clinic with a four-year history of fainting spells and convulsions. Operation was carried out the same month and a left cerebral hemisphere tumor found. Only biopsy and decompression were performed. The histologic diagnosis was malignant glioma, probably glioblastoma multiforme. From Nov. 3 to Dec. 20, 1933, inclusive, daily x-ray treatments of 164 r in air were administered (Technic 1) to the portal overlying the site of the tumor for a total dose of 6,068 r. The tumor dose was approximately 4,500 r. Following this, the patient was symptom-free for four years. In September 1937, he was struck by an automobile and hospitalized but treated only with phenobarbital. Right-sided convulsive seizures occurred on April 15, 1938, May 20, 1938, and in December 1938. These attacks persisted, and treatment was sought at Jewish Hospital, Brooklyn, N. Y. Following a complete work-up, including pneumoencephalography, a diagnosis of left cerebral atrophy was made, with no evidence of regrowth. The progressive symptoms were ascribed to possible delayed radiation effects in the brain. The convulsive seizures continued and the patient was admitted to Montefiore Hospital on Aug. 7, 1940. Right hemiparesis and motor aphasia were present and were believed to be due either to trauma sustained in the accident or to recurrence of tumor. The patient was discharged but, because symptoms persisted, was readmitted on July 9, 1941. A deep-seated expanding lesion in the temporal, motor, and inferior parietal areas was diagnosed. From Aug. 21 to Nov. 17, inclusive, 3,000 r with scatter was administered to each of four portals, with Technic 2. Marked improvement in the motor aphasia and in the ability to use the right arm followed. Symptoms recurred on March 17, 1942. The patient slowly became worse and died on July 28, 1943.

At necropsy, the left hemisphere of the brain was found to be larger than the right. The frontal convolutions were flattened. A hemorrhagic tumor nodule was present in the left third frontal gyrus. Other small hemorrhagic nodules were seen in the left precentral gyrus and the superior temporal gyrus. Section of the frontal lobes disclosed a large hemorrhagic and necrotic neoplasm measuring 5 × 3 cm. and involving both white and gray matter. Microscopic examination confirmed the diagnosis of glioblastoma multiforme. The survival of fourteen years from the onset of symptoms is one of the longest on record for glioblastoma multiforme.

The length of the preoperative period in the foregoing case demonstrates that glioblastoma multiforme may, in some instances, have a long latent period during which the patients do very well because growth is slow. This may explain the good results obtained in some cases before resort to operation. Once the disease has lost this latency, growth is rapid and surgery is necessary. As a rule, patients then do badly.

ASTROCYTOMAS

Fibrillary and protoplasmic types of astrocytoma were classified together. Twenty-one patients are included in this group. Fifteen of the tumors were cerebral in origin and 6 arose in the cerebellum.

Cerebral Astrocytomas: The ages of the 15 patients with cerebral astrocytomas varied from sixteen to forty-eight, the average was 34.6 years. There were 10 females and 5 males. The average survival period from the date of the first operation was 29.7 months. This is less than the survival period of 37 months reported by Dyke and Davidoff for a comparable group of irradiated patients, and by Davidoff of 35.8 months for the postoperative non-irradiated cases from Cushing's material (5). Only 2 of our patients lived less than one year following operation. Three patients are still living in good health, 35, 27, and 19 months following operation.

Dyke and Davidoff noted that the type

[3] This case forms part of a report by Netsky, M. G., August, B., and Fowler, W.: The Longevity of Patients with Glioblastoma Multiforme. J. Neurosurg. **7**: 261–269, 1950.

TABLE III: ASTROCYTOMA: RELATION OF SURVIVAL PERIOD TO DOSAGE

Montefiore Hospital Number	Age at Operation	Operation	No. of Courses and Technic of Irradiation*	Roentgens to Scalp	Tumor Dose (r)	Post-operative Survival
Cerebral						
35746	31	Partial removal	3 with 1	26,050	15,960	7 yr. 7 mo.
34957	37	Biopsy	4 with 1	12,000	7,360	5 yr. 8 mo.
44016	48	Subtotal removal	4 with 1	12,000	7,390	3 yr. 3 mo.
42912†	29	Subtotal removal	2 with 1	12,650	6,685	2 yr. 11 mo.
38921	34	Subtotal removal	1 with 1	4,800	3,300	2 yr. 6 mo.
26711	47	Subtotal removal	3 with 1	34,450	16,380	2 yr. 6 mo.
44327†	33	Biopsy	1 with 1	15,650	6,712	2 yr. 3 mo.
39436	25	Subtotal removal	2 with 1	9,600	5,700	1 yr. 10 mo.
26582	32	Decompression	1 with 1	3,000	1,670	1 yr. 8 mo.
46241†	16	Partial removal	1 with 1	3,000	2,190	1 yr. 7 mo.
27516	40	Partial removal	4 with 1	9,700	5,350	1 yr. 6 mo.
33649	37	Subtotal removal	3{2 with 1, 1 with 2	18,800	13,700	1 yr. 4 mo.
34379	29	Biopsy	2 with 1	6,000	3,720	1 yr. 4 mo.
37287	39	Partial removal	2 with 1	14,400	8,280	9 mo.
39989	43	Evacuation of cyst. Biopsy	2 with 1	6,400	3,444	6 mo.
Cerebellar						
43385	5	Subtotal removal	7 with 1	14,000	7,980	13 yr.
31130	25	Partial removal	5{1 with 1, 4 with 2	40,500	24,700	6 yr. 5 mo.
40018†	5	Partial removal	4{3 with 2, 1 with 1	13,500	9,720	4 yr. 4 mo.
39354	5	Biopsy	2 with 1	6,000 in air	4,060	3 yr. 4 mo.
42153†	9	Total removal	1 with 1	4,000	2,360	3 yr. 3 mo.
42231†	16	Partial removal	4 with 1	23,550	14,300	1 yr. 7 mo.

* Technic 1 = 200 kv. Technic 2 = 400 kv. See text for details.
† Still living as of June 1950.

of operation had little influence on the course of the disease. This apparently was also true for our group. Four patients had a partial excision of the growth, with an average postoperative survival of 34.2 months, though this high figure is due to the fact that one patient lived for 91 months. Six patients had a subtotal removal and lived for an average of 28.6 months, and 4 patients with only a biopsy lived 29.2 months (average).

The relation of survival period to the amount of radiation received was also investigated (Table III). The 3 patients still living received total doses to the skin of 12,650 r, 15,650 r, and 3,000 r. Though some patients given large total doses had short survivals, the longest survival periods were associated with the larger total doses. The value of this observation is limited, however, because of the small size of the group. It is interesting to note that in the case of patient M. F., still living, clinical improvement coincided with the second course of irradiation for recurrence of symptoms (Case 2, below). For most of the group, radiation therapy was not followed by improvement.

CASE 2: M. F. (Montefiore Hospital No. 42912), female, aged 29 years. During July 1947, a radical but incomplete removal was done of a right frontal parasagittal infiltrating fibrillary astrocytoma. Postoperatively, a total of 9,650 r was administered with Technic 1, over right frontal, right lateral, and vertex portals, for a tumor dose of 5,014 r. The patient did well for seventeen months, when headaches recurred. She was then given another 1,000 r to each of the above fields, with the same factors. The headaches disappeared following the irradiation and the patient has remained well to the present time, thirty-five months postoperatively.

Cerebellar Astrocytomas: The ages of the 6 patients with cerebellar astrocytoma ranged from five to twenty-five and averaged 10.9 years. In the Dyke and Davi-

TABLE IV: CEREBELLAR MEDULLOBLASTOMA. RELATION OF SURVIVAL PERIOD TO DOSAGE

Montefiore Hospital Number	Age at Operation	Operation	No. of Courses and Technic of Irradiation*	Roentgens to Scalp	Tumor Dose (r)	Post-operative Survival
41023†	24	Gross removal	1 with 1	9,175	5,500	4 yr. 1 mo.
41609†	36	Subtotal removal	3 with 1	7,000	4,920	3 yr. 6 mo.
46214†	15	Biopsy	1 with 2	6,000	3,520	1 yr. 8 mo.
24526	10	Partial removal	1 with 1	6,000 plus radium pack	3,580 from x-ray tr.	2 yr. 1 mo.
39800	12	Subtotal removal	3 with 2	9,000	4,860	1 yr. 10 mo.
6362	4	Partial removal	4{1 with 1, 3 with 2	12,200	8,900	1 yr.

* Technic 1 = 200 kv. Technic 2 = 400 kv. See text for details.
† Still living as of June 1950.

doff series, the average was 9.3 years. The average survival period from the date of the first operation was 81.6 months (Table III), considerably longer than the 57 months reported by Dyke and Davidoff. Three of the patients are still living and in good health, with few complaints. Two of them had partial resections; in the third a gross total removal was accomplished. The longest survival, 13 years, was in a patient who had a subtotal resection. She finally succumbed to the disease.

The relation of survival period to the amount of irradiation received is interesting. Our longest survivals, including both dead and living patients, were associated with the largest total dosages and with intensive irradiation (Table III). It should be noted that the one patient who had a total resection received only 4,000 r and is still living, in good health, 3 years and 3 months later. It is also of interest that B. K., our oldest patient when operated on, had a number of recurrences and always improved when additional irradiation was given. In this rather small series, a few patients who received more intensive therapy survived long periods, but for the entire group it is not possible to correlate dosage and longevity.

It is important to compare the behavior of cerebral and cerebellar astrocytomas. The cerebellar lesions are preponderant in younger individuals, they respond better to irradiation, and the survival period following operation is much greater. A case is cited to show reaction to roentgen therapy and longevity in this group.

CASE 3: N. A. (Montefiore Hospital No. 40018), male, aged 6 years, was admitted Feb. 8, 1946, with occipital headaches, unsteadiness of gait, and cranial nerve involvement consistent with a brain stem tumor, of three years' duration. In April 1944, he had been seen by one of us, who advised roentgen therapy. He received at that time 2,000 r each to right and left lateral portals, with Technic 1. Following irradiation, vomiting ceased, facial paralysis and eye deviations improved, and headaches, dizziness, and unsteadiness disappeared. The child was well for twenty-two months, when headaches, unsteadiness, and vomiting recurred and he was admitted to the hospital. Operation on Feb. 12, 1946, revealed a neoplasm of the pons, with extension into the fourth ventricle. A cyst was evacuated and the growth partially removed. The histologic diagnosis was fibrillary astrocytoma. Postoperatively, three courses of irradiation were given with Technic 2, at approximately monthly intervals, over three fields, right and left lateral and posterior. The first series totaled 3,500 r with scatter; each of the other two series 3,000 r. The tumor dose for the three series was 5,981 r.

The youngster has made an excellent recovery, has no complaints, and gets along well in school. The postoperative survival is 4 years and 4 months, the survival from the first course of irradiation is 6 years and 1 month.

MEDULLOBLASTOMA

The medulloblastoma group consists of 6 patients, 5 males and 1 female. In several cases originally treated as medulloblastomas the diagnosis was changed to primary cerebellar sarcoma when the histology was reviewed. These cases will be discussed in greater detail under the latter heading. The ages of the patients with medulloblastoma ranged from four to thirty-six, with an average of 16 years and 10 months. The operations performed were gross total removal in 1 in-

TABLE V: CEREBELLAR SARCOMA. RELATION OF SURVIVAL PERIOD TO DOSAGE

Montefiore Hospital Number	Age at Operation	Operation	No. of Courses and Technic of Irradiation*	Roentgens to Scalp	Tumor Dose (r)	Post-operative Survival
38378	16	Partial removal	14 {8 with 1, 6 with 2}	43,050	26,470	9 yr. 6 mo.
43519	29	Gross total removal	1 with 1	8,175	5,032	2 yr. 10 mo.
39953	22	Gross total removal	2 with 2	5,350	3,550	1 yr. 4 mo.
26444	27	Subtotal removal	1 with 1	4,550	2,760	3 mo.

* Technic 1 = 200 kv. Technic 2 = 400 kv. See text for details.

stance, subtotal removal in 2 cases, partial removal in 2, and biopsy in 1.

One to three courses of irradiation were given, with total doses on the skin from 6,000 to 12,200 r. The radiation was directed not only to the cerebellum but also included the basal cisterns, since tumor implantations sometimes occur in these spaces. The entire spinal axis was also irradiated because of possible implantation. The shortest postoperative survival was 12 months. Three patients are still living, 4 years and 1 month, 3 years and 6 months, and 1 year and 8 months following operation. The average postoperative survival is 28.3 months as compared to 22.3 months for Dyke and Davidoff.

For this series the longest survivals were associated with the large dosages (Table IV), as was noted also by Dyke and Davidoff. Patient R. M., still living, representing our longest survival, received only one course of intensive irradiation for a tumor dose of 5,500 r. The response to irradiation in this instance is striking, even for medulloblastoma, and is in agreement with the reports of others of the radiosensitivity of this neoplasm. In cases 39800 and 6362, which received large total dosages, the patients did badly and had repeated courses of therapy. This is also in accord with the observations of Dyke and Davidoff, and others, of the great variation in response to radiation shown by these histologically similar tumors. The case of R. M. is being reported in some detail because of the long survival following operation and irradiation.

CASE 4. R. M. (Montefiore Hospital No. 41023), male, aged 24 years, was admitted to the hospital May 20, 1946, complaining of speech difficulty, walking disturbance, matutinal vomiting, diplopia, and headache. The findings were those of a cerebellar lesion. On May 27, a suboccipital craniectomy was done with gross total removal from the right cerebellar hemisphere of a large, soft, non-encapsulated tumor. The pathologic diagnosis was medulloblastoma. The postoperative course was stormy. Roentgen therapy was started on the ninth postoperative day. From June 5 to June 10, inclusive, 3,100 r each was given to the right and left lateral portals, 12 × 10 cm., and 2,975 r to an occipital field, 9 × 10 cm., with Technic 1. The tumor dose was about 5,500 r. The period of irradiation was marked by intermittent fever and frequent spontaneous sudden vomiting, upon occasion necessitating intravenous feedings and transfusions. The decompression was tense, and the patient had some memory defect, bilateral papilledema, and return of the cerebellar signs. In September 1946, improvement set in and was progressive. It is now four years and one month since operation. The patient has married and has no complaints and few findings referable to his old cerebellar lesion.

CEREBELLAR SARCOMA[4]

Primary cerebellar sarcoma is a relatively new entity. Although described by Hsü in 1940 (6) and by Percival Bailey in 1942 (7), it is generally unrecognized. This is due not so much to the rarity of the growth as to the fact that it is usually mistaken for medulloblastoma. Histologically, it closely resembles this latter tumor, and 3 of the 4 cases to be reported were so diagnosed. The early clinical picture also simulates medulloblastoma and adds to the confusion. As in the case of medulloblastoma, seeding may occur in the spinal dura, apparently confirming the mistaken

[4] Detailed report in press, by Zimmerman, H. M., Netsky, M. G., and Berkman, J., Department of Pathology, Montefiore Hospital for Chronic Diseases.

diagnosis. Later in the course, metastasis may take place outside the central nervous system, to other organs or the skeletal or lymphatic system. The diagnosis then becomes apparent.

Four patients, 1 male and 3 females, formed this group. At the onset of the ailment, the ages were twenty-seven, twenty-two, and sixteen years for the girls, and twenty-nine years for the man. The tumors were grossly removed in 3 cases and partially removed in 1. The longest survival was 9 years and 6 months postoperatively, the shortest 3 months (Table V). Roentgen therapy was of value for palliation in 3 of the 4 cases.

CASE 5: E. R. (Montefiore Hospital No. 38378), female, aged 23 years. This case is an example of cerebellar sarcoma mistakenly diagnosed as medulloblastoma. Early in 1937, when sixteen years of age, the patient had a partial removal of a cerebellar neoplasm, diagnosed as medulloblastoma, at the Neurological Institute, New York. From March 1938 until November 1944, she received eight courses of radiotherapy at the Neurological Institute, with Technic 1. Treatment was given through two cerebellar ports, 8 × 8 cm., in bilateral opposing fashion. Each course of therapy lasted from three to five weeks, the patient receiving approximately 800 r to each cerebellar field per series. The first two courses were two months apart, the second three courses were approximately one year apart, and the last three courses in 1944 were three months apart. The first five series were given in the absence of symptoms. The last three series were given because of recurrences clinically, and each was followed by temporary improvement. At the Neurological Institute, during the over-all treatment time of 6 years and 8 months, the total dose to each cerebellar portal was 6,800 r in air. The spine was also treated during an over-all period of 6 years and 1 month, ending April 1944, the total dose (in air) being approximately 2,600 r to the cervical, 3,800 r to the dorsal, and 1,800 r to the lumbar area. When symptoms again recurred in December 1944, the patient was refused further irradiation and was referred to Montefiore Hospital, complaining of pain in the lower extremities and diplopia. From January 1945 until death on July 15, 1946, she received six additional courses of radiotherapy with Technic 2. Three ports were employed, right and left lateral and occipital, 8× 10 to 8 × 11 cm., cross-firing the cerebellar region. During the additional over-all treatment of 1 year and 6 months, the dose to the three cerebellar fields was 29,450 r. The total dose to the tumor at the Neurological Institute and Montefiore Hospital was approximately 32,400 r. The skin overlying the spine received the following total doses; cervical 8,025 r, dorsal 5,950 r, lumbar 10,350 r. The patient was well for 7 months following the first course of radiotherapy at the Montefiore Hospital. Temporary improvement followed each subsequent group of treatments, but recurrences took place ever more rapidly. Irradiation to the skull, at Montefiore Hospital, was limited to the cerebellar region, since there was no definite proof of extension and because the patient, who was a very pretty girl, objected to losing her hair over the entire skull.

The postmortem examination of the brain was most interesting. The right hemisphere was smaller than the left. All the convolutions, especially on the left, were flattened and all the fissures narrowed. A large neoplasm involved the left orbital gyrus and the right gyrus cinguli. A tumor nodule was present in the right cerebellar hemisphere. Part of the cerebellum, bilaterally, was macerated. Coronal sections of the brain showed the white matter of the left hemisphere to be markedly edematous, and tumor extended to the first orbital convolution. Cystic degeneration was observed in the left orbital convolution. The pons was enlarged and somewhat edematous and contained a few venous angiomas. Microscopic examination showed the neoplasm to be a sarcoma which had originated in the cerebellum.

Clinically, this neoplasm had behaved like a medulloblastoma and had been treated as such. The postmortem examination established the correct diagnosis. The roentgen therapy was limited to the occipital region at both hospitals. However, death was due to extension of the growth to non-irradiated brain. The scalp, calvarium, and brain tolerated an enormous amount of radiation. The total dose of 43,050 r (13,600 r/o plus 29,450 r with scatter) to the skull and 32,400 r to the tumor is one of the largest ever recorded for irradiation of the human brain.

CASE 6. B. F. (Montefiore Hospital No. 43519), male, aged 29 years. This case had a clinical course typical of the usual cerebellar sarcoma. The patient was first admitted to Montefiore Hospital on Sept. 17, 1947, with a history and findings typical of a cerebellar lesion. On Sept. 23, 1947, a suboccipital craniectomy was carried out, with gross total removal of a primary left cerebellar tumor, diagnosed histologically as sarcoma. The patient was given a postoperative course of roentgen therapy, and from Oct. 2, to Nov. 17, 1947, received 2,725 r, with Technic 1, to right and left lateral and occipital portals, 8 × 12 cm., cross-firing the cerebellum. The tumor dose was 5,032 r. Marked improvement en-

sued for 7 months, after which the patient experienced aching pain in the lower back, radiating into the left thigh, and weakness of the lower extremities, due to a lesion at L-3 and L-4. Another course of roentgen therapy was given from Aug. 13 to Nov. 26, 1948 (Technic 2), 2,450 r being delivered over a posterior central and 2,000 r over right and left lateral pelvic portals, cross-firing the lumbosacral region, and 3,000 r over the dorsal spine. Relief of pain followed the irradiation.

There were three subsequent admissions, principally because of skeletal pain. X-ray studies revealed osteoclastic metastases to the pelvis, upper femora, sacrum, ribs, and cervicodorsal spine. The spleen was enlarged, as were the axillary and supraclavicular lymph nodes. Biopsy of a supraclavicular node showed sarcoma. Additional roentgen therapy was administered, 2,000 r over each of two posterior pelvic portals, with Technic 2. The patient died May 2, 1950, thirty-four months postoperatively.

Postmortem examination revealed numerous flat plaques of tumor tissue on the dura covering the brain. Tumor was present in both frontal lobes and scattered throughout the cerebral hemispheres, and a tumor nodule was found in the folia of the left cerebellar hemisphere. The outer dural surface of the spinal cord was tumor-free. The leptomeninges contained numerous tumor nodules similar to those observed in the cerebral leptomeninges, grossly resembling the dissemination seen in medulloblastoma. In a few places, the cord itself appeared to have been penetrated. In the cauda equina region, the growth completely filled the subarachnoid space and the conus medullaris lay in a shell of tumor. The microscopic diagnosis was cerebellar sarcoma with widespread seeding of the central nervous system.

SPONGIOBLASTOMA POLARE

In 3 cases in our series the tumor was a spongioblastoma polare. In 2 the lesion was cerebral; in the third, it arose in the pons. The cerebral tumors usually occur in young people; but the 2 cases reported by Dyke and Davidoff and both of ours were in older individuals. Our patients were not helped by roentgen therapy.

MENINGEAL SARCOMA

Three of our cases are recorded as meningeal sarcoma. Two patients had two operations apiece. In each instance, a diagnosis of meningioma was made at the first operation and, when reoperation became necessary, the histologic diagnosis was changed to meningeal sarcoma. Roentgen therapy was given postoperatively. One patient is still living, 33 months following the second operation. The other returned to South America and has been lost to follow-up. In the third case the diagnosis was mesenchymal meningioma with malignant characteristics. The patient ran a fulminating course uninfluenced by roentgen therapy and died 18 months following operation. Dyke and Davidoff listed 2 cases of meningeal sarcoma. One of these was a true meningeal sarcoma, with survival 10 months following operation, with no evidence of recurrence. Death was due to inflammatory changes in the brain, the result of radiotherapy given in a single intensive dose through the open wound. The second patient's tumor was diagnosed as meningioma with sarcomatous elements. He had multiple recurrences, which were uninfluenced by roentgen therapy and required surgical removal. He lived for about 3 years following the first operation. The case history of our surviving patient follows.

CASE 7: A. G. (Montefiore Hospital No. 43240), male, aged 7 years 6 months, entered Montefiore Hospital on Sept. 17, 1947. In April 1946, at another hospital, he had undergone an incomplete removal of a tumor from the right frontotemporal region. The diagnosis was meningioma with no evidence of malignancy. The lesion recurred and the patient was given a few high-voltage x-ray treatments over the right temporal region for a total dose of 550 r with Technic 1. He failed to improve and therefore sought treatment at the Montefiore Hospital. On Sept. 27, 1947, a large tumor was resected from the right temporal and frontal lobes, diagnosed histologically as meningeal sarcoma. Postoperatively, the patient received (Oct. 1 to Dec. 11) 2,900 r in air to right and left temporoparietal ports, 2,750 r to the right vertex, and 1,900 r to a right frontal portal for a tumor dose of approximately 5,034 r (Technic 1). He is living and well 33 months following the second operation.

EPENDYMOMAS

Only one ependymoma was available for study. The tumor was located in the left temporal lobe. Dyke and Davidoff reported on 8 cases, 4 arising in the cerebrum and 4 in the cerebellum. They

noted a striking difference in behavior of these histologically similar tumors, those located in the cerebellum running a more benign course than the cerebral ependymomas. They also noted the occasional development of spinal implantations, and therefore advised prophylactic irradiation of the spinal cord. Our patient lived for 17 months following operation. Since these lesions are uncommon, this case is reported in some detail.

CASE 8: S. B. (Montefiore Hospital No. 41439), male, aged 58 years, was admitted to Montefiore Hospital with a history of loss of sense of smell for four years, inability for six months to remember names and words, and headaches for three months. Neurologic examination indicated a lesion in the left posterior temporo-occipital region. On Jan. 16, 1946, a left lateral craniotomy was done, exposing a left temporal tumor, which was completely removed. The pathological diagnosis was ependymoma. Some infection persisted about the wound margins, and the patient was readmitted March 24, 1947. On April 17 the bone flap was excised. The wound healed slowly and the patient was discharged May 8. In August and September of 1947 he was given a course of roentgen therapy, receiving 1,200 r to the vertex and two lateral portals, all 10 × 10 cm., with Technic 1. He continued to lose ground and died in July 1948.

SUMMARY AND CONCLUSIONS

A group of brain tumors is reviewed in which postoperative roentgen treatment was given, principally by a single protracted course of irradiation, but including also some cases treated by multiple short series. The preferred method of irradiation and what constitutes adequate dosage are still unsolved problems.

In the glioblastoma multiforme group, which comprised 30 patients, survival was not influenced by the type of operation nor the amount or method of postoperative irradiation. Nitrogen mustard, used in 4 patients, was also of no avail. One patient lived fourteen years from the onset of symptoms, representing one of the longest survivals on record for this type of glioma. Operation did not become necessary for this patient for four years. Another patient was given a single intensive course of radiotherapy three months following the onset of symptoms and remained well for four years before operation became necessary. The long preoperative course in these 2 cases indicates that, in some instances, glioblastoma multiforme may have a long latent period during which the patients do very well because growth is slow.

Fifteen patients were classified as having cerebral astrocytomas. In this group the longer survivals appeared to be associated with the larger total doses of radiation. However, some patients with large total doses did not respond. Radiotherapy was of no value for most of the group. Six patients had cerebellar astrocytomas. The response of these tumors to irradiation was better than that of the cerebral lesions and the survival period following operation was much longer.

There were 6 cases of cerebellar medulloblastoma. The longest survivals were associated with the larger roentgen dosages.

Of 3 cases of spongioblastoma polare, 2 were cerebral in origin and the third arose in the pons. They were not influenced by roentgen therapy.

Three cases were classified as meningeal sarcoma. One patient did well with irradiation and is still living, thirty-three months following the second operation. The other 2 patients did not respond and died.

There were 4 cases of primary cerebellar sarcoma. This is a relatively new entity, sometimes mistaken for medulloblastoma. Roentgen therapy was of distinct value for 3 of the 4 patients.

One case of ependymoma completes the series.

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SUMARIO

Roentgenoterapia de las Neoplasias Primarias del Cerebro

En el grupo de tumores cerebrales repasado, se había administrado roentgenoterapia postoperatoriamente, principalmente en una serie única y prolongada de irradiación, aunque algunos casos habían sido tratados con varias series cortas. La técnica preferible y lo que constituye una dosis adecuada representan todavía problemas irresueltos.

En el grupo del glioblastoma multiforme, que comprendía 40 enfermos, la sobrevivencia no fué afectada por la clase de la operación ni por la cantidad o técnica de la irradiación postoperatoria. La mostaza de nitrógeno, usada en 4 pacientes, tampoco surtió efecto. Un enfermo vivió catorce años desde la iniciación de los síntomas, representando una de la sobrevivencias más largas que se hayan descrito para gliomas de esta forma. La operación no resultó necesaria para este paciente por cuatro años. Otro enfermo recibió una sola serie intensa de radioterapia tres meses después de la iniciación de los síntomas y continuó bien por espacio de cuatro años antes de necesitarse la intervención cruenta. La prolongada evolución preoperatoria en esos 2 casos indica que, en algunas ocasiones, el glioblastoma multiforme puede mostrar un prolongado período de latencia durante el cual los enfermos lo pasan muy bien por ser lento el desarrollo del tumor.

A 15 pacientes se les clasificó como casos de astrocitoma cerebral. En este grupo, las sobrevivencias más largas parecieron enlazarse con las mayores dosis totales de irradiación, aunque no respondieron algunos enfermos que recibieron grandes dosis totales. La radioterapia no mostró utilidad en la mayor parte del grupo. Seis enfermos tenían astrocistomas cerebelares. La respuesta de estos tumores fué mejor que la de las lesiones cerebrales, y el período de sobrevivencia mucho más largo.

Hubo 6 casos de meduloblastoma cerebelar, asociándose en ellos las sobrevivencias más largas con las dosis mayores de rayos X.

De 3 casos de espongioblastoma polar, 2 tenían su asiento en el cerebro y el tercero se había originado en el puente de Varolio. No fueron afectados por la roentgenoterapia.

Tres casos fueron clasificados como sarcoma meníngeo. Un enfermo lo pasó bien con la irradiación y todavía vive, a los treinta y tres meses de la segunda operación. Los otros 2 pacientes no respondieron y han muerto.

Hubo 4 casos de sarcoma cerebelar primario. Trátase de una entidad relativamente nueva, confundida a veces con el meduloblastoma. La roentgenoterapia resultó de valor decidido para 3 de los 4 enfermos.

Un caso de ependimoma completa la serie.

Studies with Radioiodine

I. Function and Rate of I^{131} Uptake of Thyroid[1]

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THIS PAPER IS concerned with a study of the correlation of the rate of uptake of I^{131} in the thyroid with the clinical evaluation of thyroid function as determined by history, physical examination, and other laboratory procedures.

It is important to recognize that the diagnosis of hyperthyroidism is entirely a clinical one and can never be dependent upon any laboratory test unless the disease ultimately can be defined in terms of such a test.

From one point of view, all diseases can be divided into two groups: those whose diagnosis depends upon their symptoms and signs and those whose diagnosis is based upon the objective examination and interpretation of a specimen removed from the patient or of a test performed on the patient. In the latter case, the diagnosis is defined by the specimen or test; in the former, the results of tests or procedures on the patient can at most have correlative significance with the clinical diagnosis. For example, a tissue specimen showing carcinoma labels the disease as cancer regardless of symptoms or signs. In the other group of diseases, of which hyperthyroidism is an example, the diagnosis is dependent only on symptoms and signs. Laboratory findings such as the galactose tolerance curves, the basal metabolic rate, the protein-bound iodine, and all radioiodine studies have a correlation with the clinical diagnosis of hyperthyroidism, but, since these tests took their original meaning and interpretation in relation to the clinical diagnosis, they can never have more meaning than was originally put into them. This could change only if it were possible to define the disease entity in terms of one of the tests. If this were done, then treatment would be carried out on the basis of the results of the test irrespective of clinical symptoms and signs.

It has become conventional to study the uptake of I^{131} in the thyroid as a function of time and to relate this to the clinical estimate of thyroid activity. The maximum uptake and the shape of the uptake curve obtained over a period of several days have been used, with clinical and laboratory evidence from the study of patients, to determine the need for definitive treatment when hyperthyroidism is suspected. Because the radioiodine studies were time-consuming, an attempt was made to find a single, more quickly obtained value from the uptake curve that might be as useful as the entire curve in differentiating the normal from the hyperthyroid patient. The rate of uptake of I^{131} in the thyroid during an interval of a few hours after its first administration to the fasting patient, expressed as per cent per hour,[2] was first tried. Most data for this study were collected on patients approximately three to six hours after the administration of the I^{131}. It was realized that the "%/hr." has meaning only if it is used as an average rate of uptake or if the uptake curve is linear during the first few hours. It seemed, from study of the curves available to us, that they were near enough to a straight line during this interval to make the "%/hr." have meaning. It was found, however, that because the early part of the uptake curves was not linear, the so-called "%/hr." was dependent upon the time at which the data were collected. It is, neverthe-

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[2] "%/hr." is the per cent of the total dose of I^{131} collected by the thyroid during the first few hours after its administration (two to six hours) divided by the time between administration and the observation.

less, a useful single value if the observations on all patients are taken at the same time after the dose is given.

The variation of the "%/hr." with time caused us to restudy the data. In this second approach the uptake of I^{131} in the thyroid during the few hours immediately after its first administration was plotted against time for individuals considered to be normal, who were used as controls; for patients suffering from diseases other than those of the thyroid; and for patients suffering from various thyroid diseases. Though this approach did not make use of a single value, it utilized only data collected within a few hours (up to seven) after the administration of radioactive iodine. A good correlation was found between high rates of uptake and hyperthyroidism and between lower rates and absence of hyperthyroidism.

I^{131} MEASUREMENTS

The slightly alkaline solution of radioiodine as received from Oak Ridge was diluted with distilled water to a concentration of about 1 mc./c.c. No iodine was added. To prepare a test dose, a volume of stock solution sufficient to provide approximately 100 microcuries of I^{131} was measured into a screw-capped bottle (2 × 2 × 8 cm.), which was filled with tap water, tightly capped, and laid on its side on a wooden block (10 × 10 × 20 cm.), so that the top side was 40 cm. below a shielded Geiger counter. A lead filter, 0.5 gm. per square centimeter, was placed between the bottle and the counter, and the number of counts per minute was determined. The content of the bottle containing the test dose and two subsequent 30 c.c. water washes were drunk through a paper straw by the patient.

When the I^{131} content of the thyroid was to be measured, the patient lay on a couch. The counter was adjusted so that it was 40 cm. above the skin over the thyroid isthmus. The lead filter previously used was placed between the patient and the counter, and the count was made. The counter and filter were next moved so that the counter was 40 cm. above the skin of the mid-thigh, and the count rate there was determined. The difference between the number of counts per minute from the neck and the thigh was considered to be due to the I^{131} in the thyroid. The ratio of the count rate from the thyroid to that from the test dose indicated the fraction of the administered radioiodine present in the thyroid. Suitable corrections to allow for decay were made. In this paper, the amount of radioiodine in the thyroid is expressed as a percentage of the administered dose.

In determining the amount of I^{131} in the thyroid, the amount of radiation from it was compared to that from a source containing a known amount of the isotope. The effects of varying the size of source, the filtration, and the counter-source distance were studied. It was found that with 40 cm. distance and 0.5 gm. per square centimeter lead filtration, no significant difference in count rate per microcurie was observed when the bottles varied from 7.5 to 60 c.c. The 1-ounce bottle was chosen as it was convenient and was a reasonable representation of the size of the thyroid of the patients considered here. When the thyroid contains radioiodine, some of the radiation comes from the front surface and some from the depths of the gland. In order to reduce the effect of this variation in the origin of the radiation on the count rate, a relatively long distance between the counter and the front surface of the thyroid is desirable. The 40 cm. distance provided sufficient accuracy for clinical work, and yet did not reduce counting efficiency below a usable level. Since a filter tends to restrict the radiation recorded by the counter to the higher energy gamma components of the I^{131} radiation, its use minimizes the errors due to self-absorption, which are greater for the soft than for the harder components. The 0.5 gm./sq. cm. lead filter was found to be adequate for this purpose and did not reduce the efficiency of counting unduly.

All the data given are in terms of the Oak Ridge millicurie as established in January

TABLE I: FREQUENCY WITH WHICH THE PER CENT-PER HOUR VALUES WERE DISTRIBUTED WITHIN THE VARIOUS PATIENT GROUPS

Per Cent Per Hour	Groups of Patients					
	I	II	III	IV	V	Total
0 through 2	94	3	18	16	2	133
3 through 5	85	6	9	22	5	127
6 through 8	16	13	2	9	4	44
9 through 11	6	32		7	4	49
12 through 14		24	1	1		26
15 through 17		18		2		20
18 through 20		22		0		22
21 through 23		8		1		9
24 through 26		11		1		12
27 through 29		2		0		2
30 through 32		4		2		6
33 through 35		2				2
36 through 38		1				1
39 through 41						
42 through 44						
45 through 47						
48 through 50		1				1
Observations	201	147	30	61	15	454
Cases	122	89	21	39	11	282

TABLE II: THE PER CENT PER HOUR CALCULATED FROM THE HIGHEST VALUES OF I^{131} UPTAKE OBTAINED IN THE CONTROL GROUP AT VARIOUS TIMES

Time (hours)	1	2	3	4	5	6	7
Highest uptake (%)	11.0	18.0	23.6	27.2	29.6	31.0	32.6
"%/hr."	11	9	7.9	6.8	5.9	5.1	4.6

1950. The number of counts per minute per microcurie of I^{131} under conditions of counting used here was constant throughout the work. This was checked by observing that the count rate per microcurie of I^{131} from various shipments of radioiodine and from the same radium source remained unchanged.

SELECTION OF PATIENTS

Patients were accepted from the Thyroid Clinic and staff physicians of the University of California Medical School and from certain other physicians and, for the purpose of the present study, were divided, by a careful evaluation of case histories and physical examinations, into those with and those without evidence of thyrotoxicosis. This was done without recourse to any laboratory findings. Consultation with the referring physicians when the cases were selected also served as an aid in determining whether the patients were really suffering from clinical thyrotoxicosis at the time of testing. It can be said that the attempt to make a proper division was as honest as it could be under the circumstances. It was made without knowing the value of the I^{131} uptake data. Unless otherwise noted, data reported are from the patient's first test.

Four hundred and twenty-seven patients were studied in the laboratory. In 292, observations were made during the first seven hours. For 282 of these, sufficient clinical data were available to permit adequate evaluation; these are included in the report. They were classified in groups as follows:

I. Euthyroid
   - Controls (25 individuals)
   - Psychiatric diagnosis
   - Delayed tooth development
   - Carcinoma of the thyroid
   - Acromegaly
   - Others

II. Hyperthyroid

III. Hypothyroid and thyroiditis

IV. Goiters
   - Non-toxic diffuse
   - Non-toxic nodular
   - Toxic nodular

V. Status of thyroid function uncertain

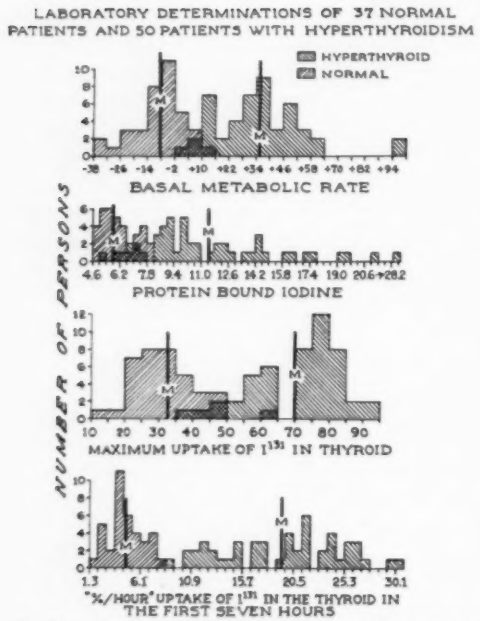

Fig. 1. Data from all of the normal (euthyroid) and the hyperthyroid patients on whom the determinations indicated were made at approximately the same time are included. The "%/hr." uptake furnished the best differentiation between these groups of patients, although each of the tests was satisfactory in this respect.

RESULTS OF "%/HR." STUDIES

Table I shows the results of the "per cent-per hour" determinations without respect to the time at which the observations were made during the first seven hours. In some cases the "%/hr." value was obtained on more than one occasion. This accounts for the fact that the number of observations exceeds the number of cases.

The data suggested that, in general, there was a difference between the "%/hr." uptake of I^{131} in the thyroid of euthyroid and hyperthyroid patients. The results were disappointing, however, in that they did not make a sharp differentiation between these groups.

Later studies showed that the uptake curve during the early hours was not linear. Therefore, the "%/hr." was not constant but depended upon the time at which the uptake was determined. The effect of this latter factor can be seen in Table II. The values given in this table were the highest found in the control group of 25 patients. While we are not at present using the "%/hr." value, it is useful if it is compared only with values obtained at a similar time.

Before the importance of the time for which the "%/hr." was calculated had been appreciated, it was compared with the basal metabolic rate, the serum protein-bound iodine, and the maximum I^{131} uptake in a group of 37 euthyroid and 50 hyperthyroid patients. All individuals for whom the four measurements were made at approximately the same time are included and the data are plotted in Figure 1. It can be seen that all the procedures make a relatively good differentiation between the normal and the hyperthyroid patients. In this particular group of patients the sharpest differentiation was made by the "%/hr." determination.

Uptake of I^{131} in the Thyroid During the First Few Hours After Its Administration: Data from the 25 healthy individuals who were considered as controls were plotted on a chart having time in hours as the abscissa and per cent uptake as the ordinate (Fig. 2). When more than one observation was available, a straight line was drawn between successive observations. A curve drawn through the highest uptake values thus plotted appears as a heavy line in Figures 2 through 6 inclusive and serves as a reminder of the highest values found in this particular control group. Data from patients of Group I through V were plotted in a similar fashion as shown in Figures 3 through 6.

In the graph showing the data for the euthyroid subjects (Fig. 3), it is seen that of the 201 observations on 122 individuals, only two on a single carcinoma patient were above the highest range of the control group.

In Figure 4 are presented 147 observations on the I^{131} uptake by 89 patients with thyrotoxicosis. Except in 5 patients, all of the observations are above the top range of our normals. Of these 5, one was taking propylthiouracil at the time of the test, one patient had been taking quinidine in the past, one is said to have shown spon-

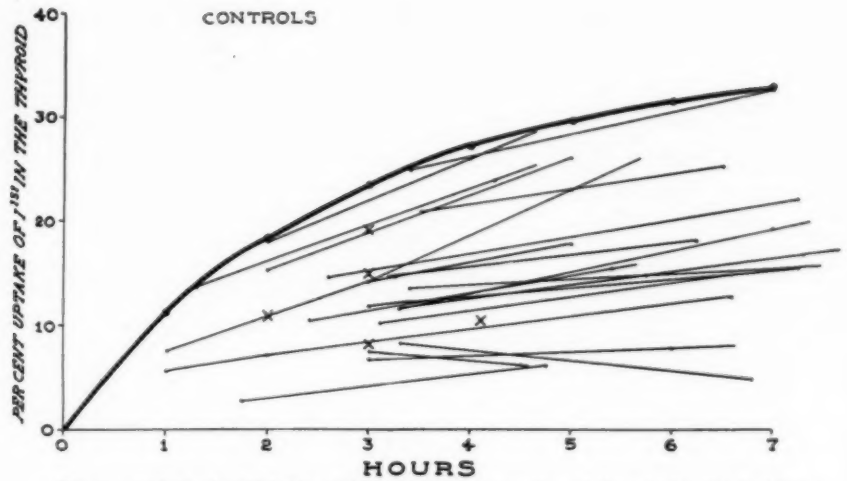

Fig. 2. Uptake of radioiodine in the thyroid as a function of time during the first few hours after its administration to a group of 25 healthy individuals. The heavy curved line is drawn to include all observations. This curve is used as a reference line in subsequent figures and will be referred to as the "reference line."

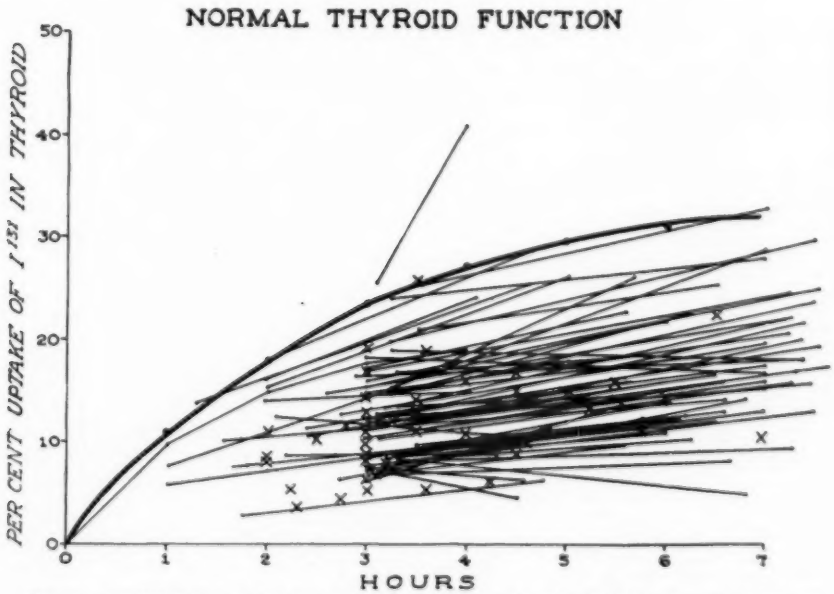

Fig. 3. Radioiodine uptake in the thyroid in 122 euthyroid individuals. The data are from patients in Group I. The group includes controls, those with psychiatric diagnoses, carcinoma of the thyroid, delayed tooth development, and acromegaly. All but 2 of the 201 observations lie below the "reference line."

taneous improvement recently, and one patient was treated at one time for depression at the Langley Porter Clinic. None of these circumstances is offered as an explanation for the normal findings in these patients. It is interesting, however, that two of the number became myxedematous after treatment.

Thirty observations were made on 21 patients with hypothyroidism or thyroidi-

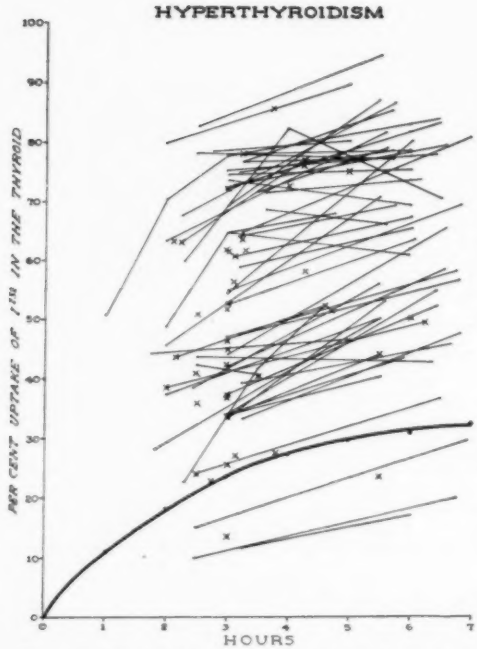

Fig. 4. I^{131} uptake in the thyroid in 89 patients with hyperthyroidism. The observations on 84 of these lie above the reference line.

tis (Fig. 5). Of these, a single early observation on a patient with hypothyroidism lay above the maximum of our normals. A later observation on this same patient was within the control range. While the uptake in a few patients was very low, in general it was similar to the control group.

There were 61 observations on 39 patients with various goiters as classified in Group IV. Table III gives the distribution of the observations with respect to the highest normal values. Two of the 8 patients with non-toxic diffuse goiters and a fifth of the 25 patients who had non-toxic nodular goiters had uptakes higher than the highest of the control group, whereas one-half of the 6 patients with toxic nodular goiters had uptakes within normal limits. Thus, in this group of patients there is a poor correlation between the clinical estimate of thyroid function and I^{131} uptake.

In the group of 11 patients whose data are shown in Figure 6 there was no clear estimate of thyroid function by the referring physician at the time of referral, nor could we make up our minds about their thyroid status. They were sent to us in order to see whether our procedure would help the physician make up his mind about their diagnosis. The observations in this group were scattered, without apparent pattern. Nine patients were ultimately

TABLE III: NUMBER OF PATIENTS IN GROUP IV WHOSE UPTAKES LIE WITHIN OR ABOVE THE RANGE OF THE VALUES OF THE CONTROLS

	Above Highest Normal	Within Normal Range
Non-toxic diffuse goiters	2	6
Non-toxic nodular goiters	5*	21*
Toxic nodular goiters	3	3
TOTAL	10	30

* One patient had one observation above and one within the normal range.

dismissed as euthyroid. In two, the diagnosis of hyperthyroidism was later made. Interestingly, the uptakes of these two patients were not the highest of the 11, but lay in the middle of the range of the group.

In a further endeavor to find a useful single value from the uptake curves, values obtained during the second, third, fourth, fifth, sixth, and seventh hours after the oral administration of I^{131} were compared for euthyroid and hyperthyroid groups. Figure 7 shows the uptakes for a group of 90 euthyroid and 76 hyperthyroid patients between three and four hours after I^{131} administration. The data are taken from individual observations within this interval or from uptake curves which pass into or through it, the per cent uptake being plotted against the number of times each particular value occurred within the hour. A similar plot was made for each hourly interval between two and seven hours. The data for the interval between three and four hours are representative of the other intervals. In Table IV an analysis of certain data obtained from these plots is presented. As an illustration of the manner in which this table was assembled, note how the following information for the three- to four-hour interval was obtained from Figure 7. There were 90 euthyroid patients

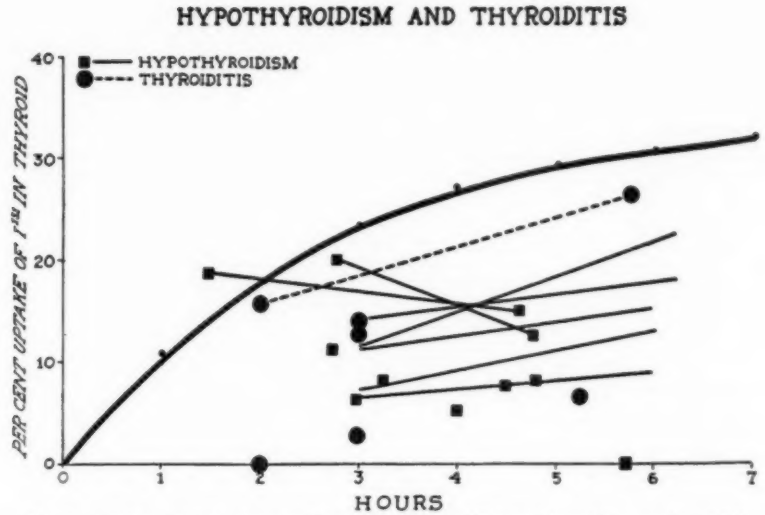

Fig. 5 Uptake of I^{131} in the thyroid in 21 patients with hypothyroidism or thyroiditis. Except for one observation, the data are scattered throughout the range found for the euthyroids.

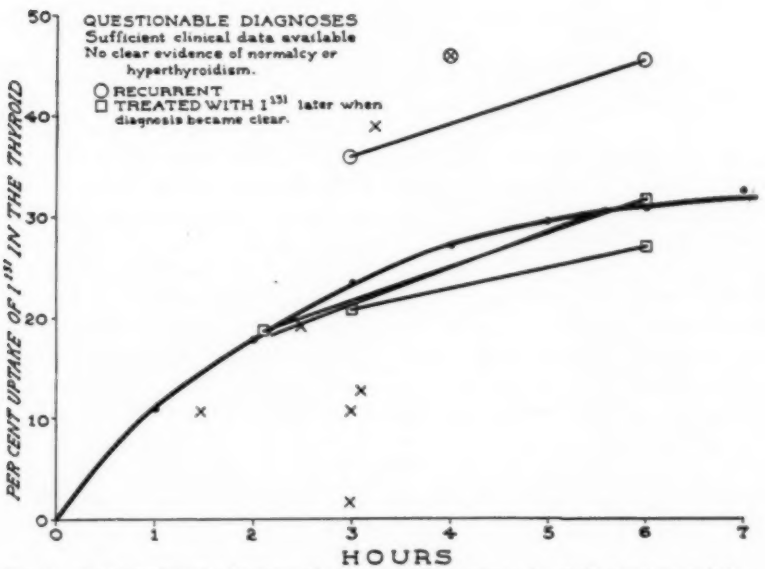

Fig. 6. Uptake of I^{131} in the thyroid of 11 patients in whom the clinical estimate of thyroid function was not clear.

on whom uptake measurements were made during the interval between three and four hours after the administration of I^{131}. Eighty-nine (98.9 per cent) of these had uptakes of 27 per cent or less during this interval. There were 76 patients with hyperthyroidism who were studied at the same interval, 71 of whom had uptakes greater than 27 per cent. Five (6.6 per cent) of the 76 hyperthyroid subjects had uptakes that lay within the limits of this euthyroid group.

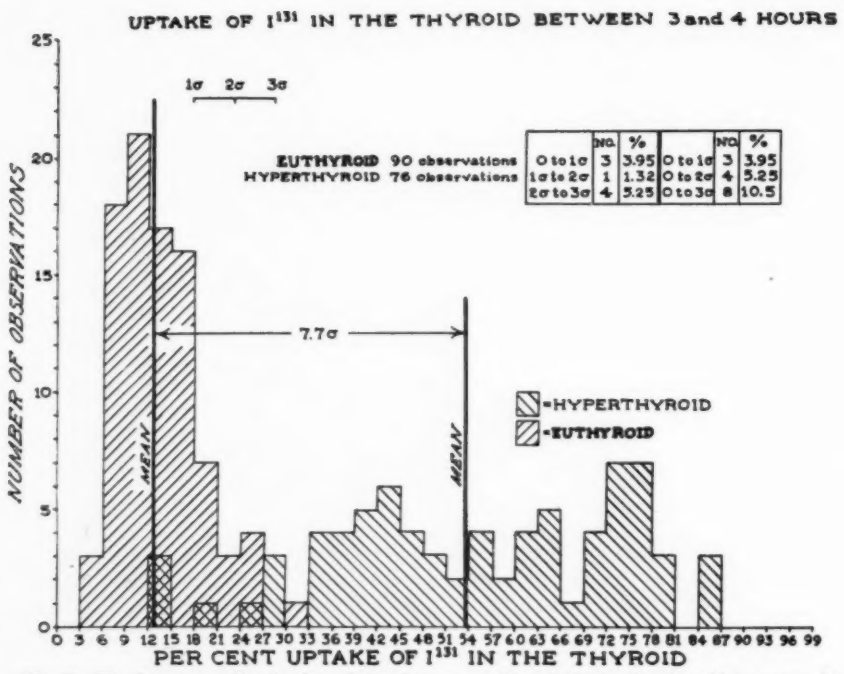

Fig. 7 The frequency distribution of the data on uptake of I^{131} in the thyroid between the third and fourth hours after its oral administration. All data available for this interval on the euthyroid and hyperthyroid individuals are included. See text and Table IV.

From Table IV it would appear that for differentiating those patients who have hyperthyroidism from those who do not, the single value of the uptake determined at any specified time between two and six hours is useful. If the interval between the oral administration of the I^{131} and the measurement of uptake is too small, there is danger that variation in the rate of absorption from the gut will affect the uptake value. It should be borne in mind that these patients were fasting when the I^{131} was given and that these statements do not apply to the data obtained from patients with nodular or colloid goiters.

The data presented refer to results obtained from the initial I^{131} tests only. This procedure appeared to have as good a correlation with clinical evaluation of thyroid function during and after a course

TABLE IV

	Interval in Hours after Administration of I^{131}				
	2–3	3–4	4–5	5–6	6–7
Number of euthyroid patients who had observations in the interval	27	90	77	65	52
"Upper limit" of normal uptakes*	21%	27%	30%	30%	30%
Number of euthyroids with values above "upper limit" of normal	0 (0%)	1 (1.1%)	1 (1.3%)	0 (0%)	1 (1.9%)
Number of hyperthyroids who had observations in the interval	54	76	58	54	31
Number of hyperthyroids with uptake below "upper limit" of normal	2 (3.7%)	5 (6.6%)	3 (5.2%)	4 (7.4%)	3 (9.7%)
Highest values of uptake found in control group	20.8%	25.4%	28.4%	30.3%	31.8%

* This limit is arbitrarily selected so that at least 98 per cent of the observations on the euthyroid patients fall below it.

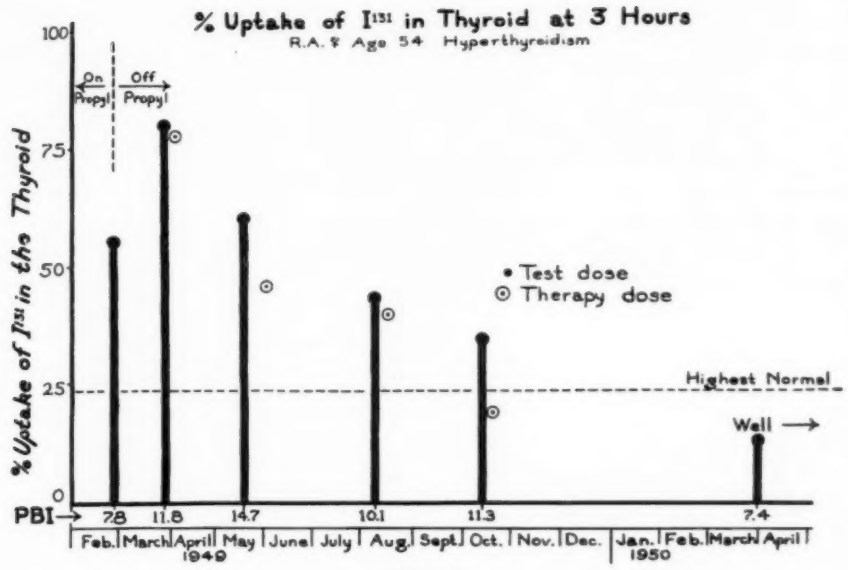

Figure 8

of I^{131} for hyperthyroidism as it does after the initial radioiodine administration.

Figure 8 illustrates the results of the procedure in a patient under treatment for hyperthyroidism.

SUMMARY AND CONCLUSION

Data were collected on the I^{131} uptake in the thyroid during the first seven hours after its administration to five groups of patients. One group was considered clinically to have normal thyroid function and a second group was considered to be suffering from hyperthyroidism. An attempt was made to find a single quickly obtained value from the uptake curve that might be as useful as the entire uptake curve in differentiating between these groups.

The uptake as given by the "%/hr." was tried first. It was calculated by taking the per cent of I^{131} collected by the thyroid during the first few hours after its administration and dividing it by the number of hours between administration and observation. Although this "%/hr." was dependent upon the time of measurement, it was as useful in these groups of patients as were the determinations of the basal metabolic rate, the protein-bound iodine, or the maximum uptake of I^{131} in the thyroid.

The absolute value of the uptake determined at any particular time between two and seven hours is of greater use than the "%/hr." in differentiating patients with hyperthyroidism from those without hyperthyroidism. This follows because of the variation of the "%/hr." with time. It has been found expedient to determine the uptake at one, three, and five hours and construct a curve with the data thus obtained. This provides three independent observations which serve as checks on one another and a curve which can be compared with the curve through the highest observations in the control group.

On the basis of the thyroid uptake during the first seven hours it was not possible to differentiate between euthyroid and hypothyroid individuals.

The results of the tests are unpredictable in patients with nodular goiters.

ACKNOWLEDGMENT: The authors take pleasure in acknowledging the technical assistance of Mrs. Marian Feigenbaum and Mrs. Louise Prestidge. Special thanks are given to the Atomic Energy Commission for its generous support and to Dr. Robert S. Stone and Dr. Shields Warren for their co-operation.

SUMARIO

Estudios con el Radioyodo. I. Función y Velocidad de la Absorción de I^{131} en el Tiroides

Los datos recogidos muestran la absorción de I^{131} en el tiroides durante las primeras siete horas después de haberlo administrado a cinco grupos de enfermos.

Un grupo fué considerado clínicamente como dotado de función tiroidea normal y otro grupo como hipertiroideo. Hízose un esfuerzo para descubrir en la curva de absorción un solo factor fácil de obtener que fuera tan útil como la curva total de absorción para diferenciar esos grupos clínicos.

Se probó primero la absorción arrojada por el "%/hr.", calculándolo a base del por ciento de I^{131} acumulado por el tiroides durante las primeras pocas horas consecutivas a la administración de la substancia y dividiéndolo por el número de horas transcurridas entre la administración y la observación. Aunque ese "%/hr." dependía del tiempo de medición, resultó tan útil en esos enfermos como las determinaciones del coeficiente del metabolismo basal, del yodo proteino-fijado, o de la máxima absorción de I^{131} en el tiroides.

El valor absoluto de la absorción determinada en cualquier momento dado entre dos y siete horas es de mayor utilidad que el "%/hr." con el tiempo. Resultó conveniente determinar la absorción a la hora, tres horas y cinco horas y construir una curva con los datos así obtenidos. Esto suministra tres observaciones independientes que sirven para mutua comprobación y una curva comparable con la arrojada por las observaciones más altas en el grupo testigo.

A base de las observaciones de la absorción tiroidea durante las primeras siete horas, no fué posible diferenciar entre eutiroideos e hipotiroideos.

Los resultados de esta prueba son impredecibles en los enfermos que tienen bocios nodulares.

DISCUSSION

Hymer L. Friedell, M.D. (Cleveland, Ohio): Dr. Miller has covered in its broadest aspects the most significant features which have developed in the use of radioiodine for the diagnosis and treatment of hyperthyroidism, and I think he has touched upon one very important point. The studies on the utilization of radioiodine by the thyroid should be so adapted as to permit measurements somewhere early in the localization of the element in the thyroid gland. We have been working in similar directions and have essentially the same concept. From analysis of data available in the literature, and from our own work, the approach that Dr. Miller has presented appears to be a useful one. I wish also to direct your attention to an excellent paper by Pochin, appearing in the *Lancet*, July 8 and 15, 1950, which I think covers this problem in a most admirable manner.

A concept which we feel merits considerable attention is the idea that uptake of iodine in the thyroid is an exponential function. This exponential increase in the thyroid is directly related to the level of radioiodine in the plasma and the avidity of the thyroid for radioiodine. The levels that may be reached in the thyroid are, of course, inversely related to loss of radioiodine through the kidney. A very close approximation may be made by the following simple mathematical analysis:

The iodine level in the plasma may be considered to be a reservoir whose level may be designated as Qp. The iodine level in the thyroid at any time may be designated as Qt and similarly the level in the kidney as Qk. Then

$$\frac{dQt}{dt} = mQp$$

$$\frac{dQk}{dt} = nQp$$

when m indicates the avidity of thyroid uptake and n represents the avidity of kidney excretion. The integration of these simultaneous equations will provide us with an exponential curve. [For those who are interested, the equations are as follows:

$$Qt = \frac{m}{m+n} Qd\ (1 - e^{-(m+n)t})$$

$$Qk = \frac{n}{m+n} Qd\ (1 - e^{-(m+n)t})\Big]$$

By cursory examination of these equations, it will be seen that the greatest successive increase in the amount of iodine in the thyroid will occur

early or when the amount of iodine in the plasma is high and that which has been taken up by the thyroid is still low; therefore, the greatest differences in successive measurements will occur immediately after the administration of the iodine dose. For this reason, I believe that Dr. Miller's approach appears to be most reasonable. I believe that an actual measurement of uptake rates might be even more useful, but it has the disadvantage of being somewhat more complicated.

This introduces problems of measurements of comparatively small amounts, since the thyroid will not be reaching its maximum levels in this early period. For this reason, we have adapted a special scintillation counter, using an anthracene crystal, to facilitate the measurement of the small amounts taken up early in the period following the administration of iodine. In addition to this, the scintillation counter permits the use of much smaller tracer doses of I^{131}. (As is well known, the scintillation counter is roughly 100 times as effective as an ordinary Geiger counter.) I am convinced that for measurement of radioactive materials in intact tissues having a gamma ray of sufficient energy to escape readily from the body, the scintillation counter is most useful.

Spontaneous Rupture of the Esophagus

With Report of Five Cases[1]

CHARLES A. PRIVITERI, M.D.,[2] and BRIT B. GAY, JR., M.D.[3]

SPONTANEOUS rupture of the esophagus is a rare condition, which until recently carried a grave prognosis. Whereas most cases reported up to 1944 had terminated fatally, there have been, as a result of improved methods of diagnosis and treatment, 16 survivals among 40 cases published during the last six years. Including the 5 examples to be presented here, the world literature contains records of 92 cases, 32 of which have been reported since 1947. So far as we are aware, a single case, that of Aldrich and Anspach (1), is to be found in the radiological literature. Adequate bibliographies are furnished by Barrett (2), Kinsella *et al.* (29), and Lynch (35).

The original description of spontaneous rupture of the esophagus is said by McWeeney (42) to be that of Boerhaave in 1724. The first antemortem diagnosis is credited to Walker in 1924 (56). At present the diagnosis is based upon the patient's history, the clinical findings, and confirmatory roentgenograms. We shall endeavor here to summarize the known facts concerning this condition, with particular emphasis on the roentgen diagnosis.

By spontaneous rupture is meant a complete tear involving all layers of the wall of a previously normal esophagus. This excludes incomplete tears and rupture at the site of neoplasm, peptic ulcer, corrosive esophagitis, other forms of esophageal inflammation, aneurysms, perforation from instrumentation, biopsy, or trauma following foreign bodies. Four incomplete tears involving the muscle and mucosal layer at the lower end of the esophagus were found postmortem by Weiss and Mallory (60). Spontaneous rupture of the esophagus occurs usually in middle-aged individuals; it is rare in children though it has been reported (38). Eighty-four per cent of the patients have been males (29). Additional information based on the collected cases is presented in Graph I.

MECHANISM OF RUPTURE

Spontaneous rupture of the esophagus is explained by most authors on the basis of sudden increase in intra-abdominal pressure due to vomiting, retching, or convulsions. The pressure is believed to be transmitted to the esophagus as a consequence of associated pylorospasm and spasm of the cricopharyngeus muscles, resulting in a tear of the lower third. The stomach contents, including air, then dissect upward along the fascial plane of the mediastinum. The air will often invade the neck. The close relationship of the left pleura to the mediastinal portion of the tear in the lower third of the esophagus explains the frequent association of left-sided hydropneumothorax. Surprisingly, no free air has ever been found within the pericardium or abdominal cavity. Mallory (60) and Barrett (2) reported the only cases showing dissection of air retroperitoneally postmortem.

The following may aid in explaining rupture of a previously normal esophagus.

1. Experimentally, Mackenzie in 1884 (40), Burt in 1931 (6), and Kinsella in 1948 (29), working with human cadavers, ascertained that 3 to 6 pounds of pressure per square inch is necessary to rupture the lower end of the adult esophagus, whereas four times that pressure is necessary to rupture the esophagus in children below twelve years of age. The tear always developed

[1] Published with permission of the Chief Medical Director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the authors. Accepted for publication in December 1950.

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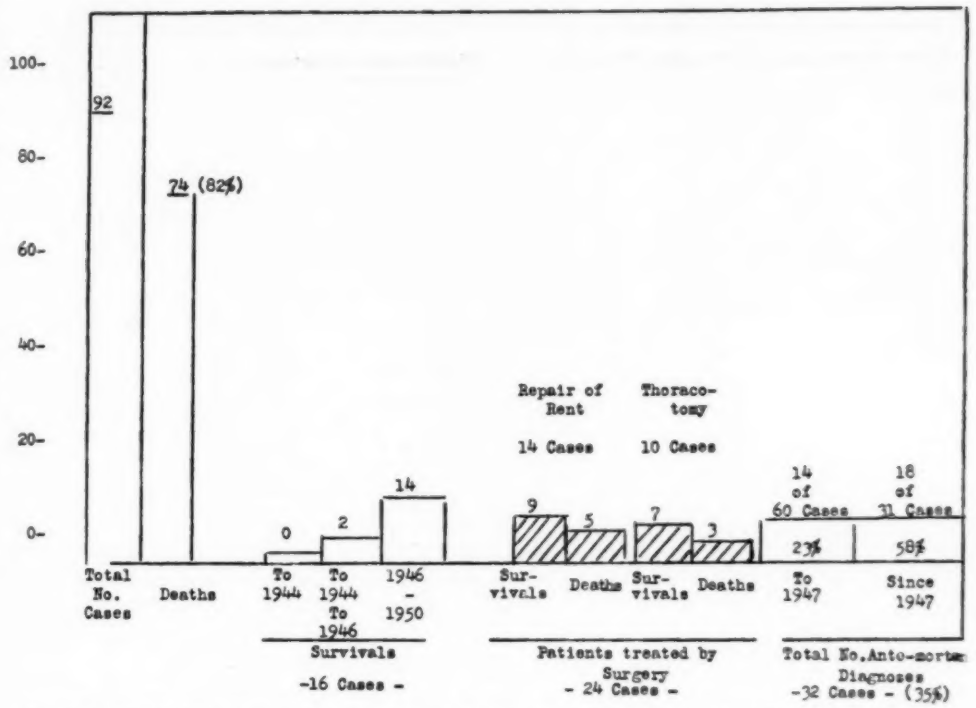

Graph 1. Statistical data on all reported cases of spontaneous esophageal rupture (including authors').

in a vertical direction. In the opinion of these authors, the sudden elevation of pressure is of more importance than the total degree in the development of tears.

2. Mosher, in 1930 (44), demonstrated the existence of a sharp anterior angulation at the lower end of the esophagus due to the crus of the left diaphragm, which lies posterior to the esophagus and is thicker than that on the right. Spontaneous rupture of the esophagus is usually at this level.

The following observations by Mosher may also be significant: (*a*) The esophageal muscles at the lower end are relatively weaker than the stomach muscles. (*b*) The esophageal muscles at the lower end terminate in a conical fashion, the tapered end being extremely thin. (*c*) Segmental defects were found in the circular muscle layer of the lower third of the esophagus in 2 of 7 cadavers dissected. (*d*) An inherent weakness exists at the site of the entrance of vessels and nerves into the musculature of the lower end of the esophagus.

Beattie (3), in 1932, noted experimentally that electric stimulation of the tuber cinereum in animals caused increased peristalsis in the stomach and hyperemia of its mucosa. Although the relationship of brain operations and of disease of the tuber cinereum and other parts of the cerebrum to spontaneous rupture has never been explained, the conditions have frequently been associated, as in Cases II, III, IV, and V of this series.

PATHOLOGY

The usual esophageal tear ranges in extent from 2 mm. to 8 cm. As pointed out above, it involves all layers and is located in the lower end of the esophagus, originating above the level of the diaphragm. In the majority of reported cases (29), tears have been vertical and on the posterolateral wall, on the left side. Right-sided tears, however, are not uncommon. In true spontaneous rupture of the esophagus, no disease process, either gross or micro-

TABLE I: PATHOLOGICAL FINDINGS IN 71 CASES OF SPONTANEOUS RUPTURE OF THE ESOPHAGUS

(From Postmortem and Operative Protocols)

Hydrothorax, right, without cervical or mediastinal emphysema and without left hydrothorax	2 (3%)
Hydrothorax, left, without cervical or mediastinal emphysema and without right hydrothorax	18 (25%)
Hydrothorax, bilateral, without cervical or mediastinal emphysema	5 (6%)
Hydrothorax, right, with cervical or mediastinal emphysema but without left hydrothorax	3 (4%)
Hydrothorax, left, with cervical or mediastinal emphysema but without right hydrothorax	21 (30%)
Hydrothorax, bilateral, with cervical or mediastinal emphysema	16 (23%)
Mediastinitis, with fluid and air in mediastinum and/or cervical emphysema, without hydrothorax	6 (9%)
TOTALS	
Hydrothorax	65 (91%)
Emphysema, mediastinal and/or cervical	46 (66%)
Hydrothorax, left only	39 (56%)
Hydrothorax, bilateral	21 (28%)
Hydrothorax, right only	5 (7%)

Findings in 21 other cases not included because of incomplete protocols. Since protocols and postmortem findings give an incomplete picture of pneumothorax, this finding is not included.

TABLE II: INCIDENCE OF INDIVIDUAL ROENTGEN FINDINGS IN 35 CASES,* INCLUDING AUTHORS'

Negative chest roentgenogram†	3
Left pneumothorax	1
Right hydrothorax	6
Left hydrothorax	13
Right hydropneumothorax	1
Left hydropneumothorax	9
Emphysema, cervical and/or mediastinal	19
Mediastinal widening	2
Mediastinal shift	4
Site of perforation demonstrated by opaque medium	9
Subdiaphragmatic free air	0

* Constituting all reported cases in which radiographic studies are reported.

† See note to Table III.

scopic, is demonstrable at the site of the tear.

Single cases of spontaneous tear in the middle third of the esophagus (16) and complete disruption of the lower end (27) have been reported. Esophageal tears have developed in patients with poliomyelitis (29), meningitis (21), paresis (20), and intracranial hemorrhage (authors' case). Tears have followed weight lifting (24), defecation (62), administration of anesthesia (50), and roentgen examination of the gastro-intestinal tract (28).

CLINICAL COURSE

According to Wangensteen (57), diagnosis of spontaneous rupture of the esophagus may often be made from the history. A previously healthy middle-aged patient having recently eaten a large meal or indulged heavily in alcoholic beverages will start vomiting or retching; sudden exquisite epigastric or substernal pain will develop, followed by severe shock. Physical examination may reveal hydrothorax or hydropneumothorax, usually on the left side, emphysema in the neck or chest wall, and a rigid but not tender abdomen. Dyspnea or cyanosis will usually develop after the onset of symptoms. The hydrothorax and hydropneumothorax usually occur during the first twelve hours, and emphysema during the first twenty-four hours, sometimes as early as two and a half hours (7). Severe hematemesis has been reported infrequently.

Roentgenograms of the chest confirm the presence of hydrothorax or hydropneumothorax. In addition, they may show widening of the mediastinum and/or mediastinal and cervical emphysema (Fig. 1 and Table II).

Subdiaphragmatic air has never been reported in spontaneous rupture of the esophagus.

The survival period after onset may be gauged from the following figures: Of 51 patients, with adequate protocols, analyzed by Kinsella (29), 13 died in less than twelve hours; 24 died in less than twenty-four hours; 8 died in less than forty-eight hours; and 8 survived longer than forty-eight hours. The cause of death was shock, respiratory and circulatory embarrassment due to severe bilateral pneumothorax, sepsis, and mediastinitis.

DIFFERENTIAL DIAGNOSIS

Intra-abdominal emergencies requiring differentiation from spontaneous rupture of the esophagus include perforation of a viscus, mesenteric thrombosis, intestinal obstruction, volvulus, strangulated bowel,

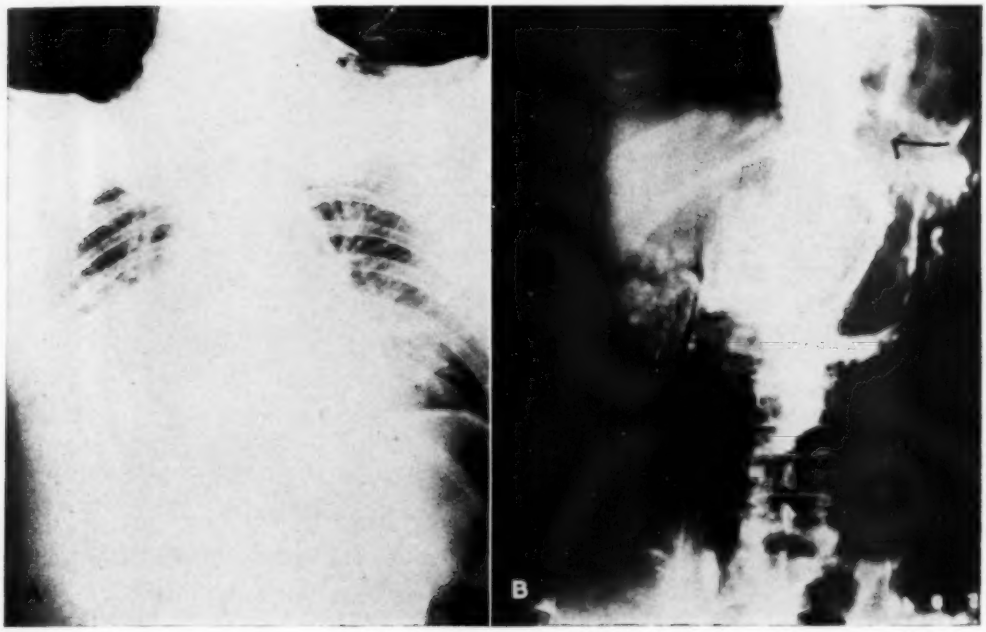

Fig. 1. Case I. A. Plain portable chest film taken two days after onset of illness and after abdominal exploration. Slight left pleural effusion and considerable emphysema in soft tissues at the base of the neck.
B. Esophagram made through Levine tube nine days after onset of illness, showing para-esophageal fistula originating in the lower esophagus.

pancreatitis, and cholecystitis. Intrathoracic emergencies such as coronary thrombosis, diaphragmatic hernia, pulmonary infarction, and dissecting aneurysm can be excluded by demonstrating a hydrothorax, hydropneumothorax, and/or emphysema in the mediastinum or neck (Case I, Fig. 1A). Free air within the peritoneal cavity has never been recorded in cases of spontaneous rupture of the esophagus.

Pleural effusion due to other causes and spontaneous pneumothorax offer the greatest problems in differential diagnosis. Uncomplicated spontaneous pneumothorax is usually not associated with large amounts of fluid. It is rarely accompanied by such severe symptoms as are seen in spontaneous rupture of the esophagus. Pleural effusion has been recorded in 91 per cent of all cases of spontaneous rupture of the esophagus. During the first twelve hours after the onset of symptoms, the effusion develops rapidly and can often be detected before emphysema becomes evident. Ob-

Fig. 1, C. Oblique view showing same findings.

viously, one cannot anticipate a spontaneous rupture of the esophagus solely because of pleural effusion. However, when the effusion is associated with severe chest or epigastric pain and shock, or when it follows a brain operation, especially if the patient goes into shock (Fig. 3), spontaneous rupture of the esophagus should be considered and an esophagram should be obtained if possible (Case III).

Rupture of the esophagus complicating a disease process such as peptic ulcer, carcinoma, etc., does not assume the emergency status of spontaneous rupture of the esophagus. In practically all cases, the primary lesion is demonstrable roentgenographically, and mediastinal and neck emphysema is rarely so extensive.

Despite the characteristic clinical picture of spontaneous rupture of the esophagus, only 35 per cent of the recorded cases have been diagnosed antemortem. Awareness and knowledge of the typical syndrome will undoubtedly aid in increasing the number of early diagnoses. It should be remembered, however, that more than one-third of all spontaneous ruptures are atypical (Case IV). Cases have been reported without pain and with only moderate shock. In such instances, pleural effusion, emphysema in the mediastinum or chest wall, and hydropneumothorax have developed suddenly (Cases I, II, and III).

ROLE OF X-RAYS IN THE DIAGNOSIS OF SPONTANEOUS RUPTURE OF THE ESOPHAGUS (Tables II and III)

Since, for all practical purposes, early diagnosis of spontaneous rupture of the esophagus does present a problem, roentgenographic confirmation is desirable and is sought by clinicians.

Roentgenographically emphysema in the mediastinum and/or neck and an esophageal fistula must be demonstrated in order to establish the diagnosis. Emphysema alone cannot be considered diagnostic, since it may originate from the respiratory tract. When, however, emphysema is associated with a typical history of intense pain and shock and/or cerebral disease or operation in a previously normal patient, the diagnosis of spontaneous rupture of the esophagus is practically established (Case I, Fig. 1A). Only a rare case of spontaneous pneumothorax must be excluded. For this reason, an esophagram, preferably with lipiodol, is desirable to demonstrate an esophageal fistula. If positive, this examination will not only establish the diagnosis but will demonstrate the site and extent of the fistula, thus aiding the surgeon in planning the operation. The fact that, to date, the site of perforation has been demonstrated by an opaque medium in only 9 cases is attributed to the lack of awareness of this condition. In emergencies of this type, films of the chest and abdomen are first requested. Roentgenograms are frequently of poor quality and therefore difficult to evaluate; nevertheless, sufficient information may be gleaned to arouse a suspicion of spontaneous rupture of the esophagus.

In addition to emphysema and fistula, roentgenographic evidence of pleural effusion or hydropneumothorax may suggest the diagnosis, especially if evaluated in the light of the clinical history. Pneumothorax without associated fluid has never been recorded in adults, but has twice been observed in children. Hydrothorax or hydropneumothorax limited to the right side has occurred in 7 per cent of all cases; it has been noted bilaterally in 28 per cent.

TABLE III: COMPOSITE ROENTGENOGRAPHIC FINDINGS IN SPONTANEOUS RUPTURE OF THE ESOPHAGUS (35 CASES, INCLUDING THE AUTHORS')

Negative postero-anterior chest examination*	3
Hydro(pneumo)thorax, left	
With emphysema, cervical or mediastinal	12
Without other findings	7
Hydro(pneumo)thorax, right	
With emphysema, cervical or mediastinal	1
Without other findings	2
Hydro(pneumo)thorax, bilateral	
With emphysema, cervical or mediastinal	3
Without other findings	1
Emphysema, cervical and/or mediastinal only†	5
Tension pneumothorax, left	1
Chest films unsatisfactory	1

* These 35 cases are the only ones found in the literature with adequate roentgen studies.

† One patient had a negative chest film (included above) but retropharyngeal and mediastinal air was demonstrated on a lateral roentgenogram of the neck.

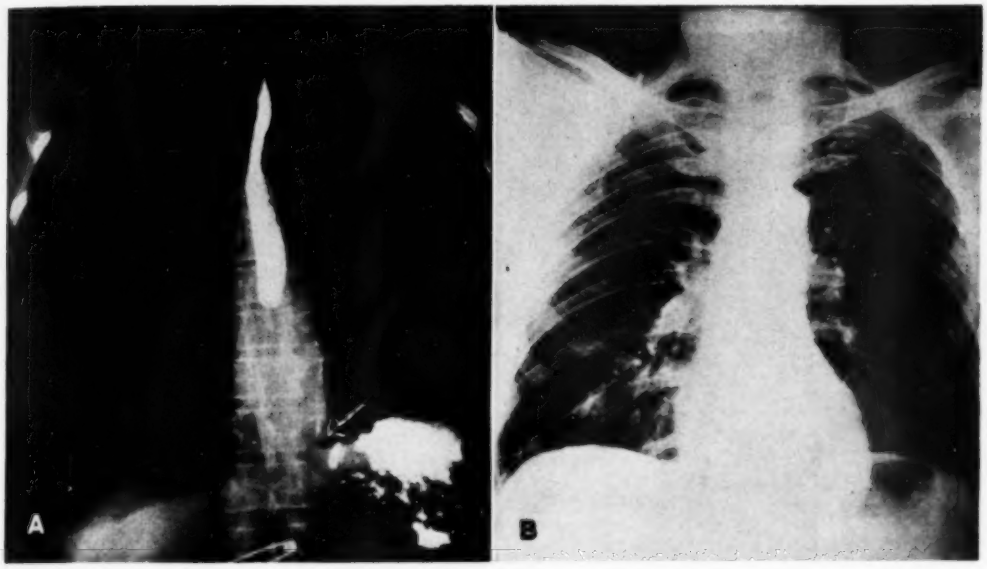

Fig. 2. Case I. A. Esophagram made forty-seven days after onset of illness. No fistula. Radiopaque linear density along periphery of widened mediastinal shadow represents residual lipiodol from previous examination.
B. Normal chest almost two months after onset of illness.

CASE REPORTS

CASE I (Figs. 1 and 2): J. A. S., 59-year-old white male, was well until April 27, 1949, when during lunch he experienced a sensation of "food sticking in his throat." He voluntarily induced vomiting and immediately experienced severe lower anterior chest pain. A diagnosis of "acute surgical abdomen" was made at another hospital. A portable chest film was regarded as negative, although in retrospect cervical emphysema could be seen. Exploratory laparotomy failed to disclose any lesion.

Following operation, orally ingested orange juice drained through the abdominal incision. On the second postoperative day, because of respiratory difficulty and dullness to percussion in the right base, a roentgenogram of the chest was taken, showing extensive cervical emphysema.

Barium studies on May 6, through a Levine tube in the stomach, demonstrated a fistula extending from the region of the gastric cardia to the anterior abdominal wall. Repeat barium studies, May 9, showed an additional large para-esophageal fistulous tract in the mediastinum without pleural communication.

When referred to the Lawson Veterans Administration Hospital on May 14, the patient was slightly irrational, undernourished, and had a bilateral hydrothorax. A loculated left and a minimal right hydrothorax were demonstrated roentgenographically. There was no cervical or mediastinal emphysema. Lipiodol esophagrams showed the mediastinal and abdominal fistulae originating in the lower 2 inches of the esophagus.

Jejunostomy, repeated thoracenteses, and blood transfusions led to gradual recovery. Barium studies of the esophagus on June 13, 1949, showed it to be normal. One month later the patient was asymptomatic, had gained weight and strength, and his abdominal and thoracic wounds were well healed.

CASE II: J. M. B., 29-year-old white male, was admitted to Lawson Veterans Administration Hospital on Aug. 31, 1949, complaining of severe frontooccipital headache of five days duration, and one attack of nausea and vomiting on Aug. 28. One day before admission, he had noticed weakness and sensory loss in the left hand.

Physical examination revealed minimal weakness of the lower left side of the face and the left upper extremity, with minimal ataxia and a positive right Babinski sign. A spinal tap showed increased pressure. Roentgenograms of the skull and chest were normal. Cerebral angiography demonstrated a 1-inch solitary aneurysm of the right middle cerebral artery, with no extravasation of dye.

The course was satisfactory until 4:00 A.M., Sept. 10, when the patient, approximately twenty hours after falling out of bed, became comatose and Cheyne-Stokes respiration developed. A craniotomy was done at 2:00 P.M. of the same day, and a right temporofrontal subarachnoid hemorrhage was found. The right middle cerebral artery aneurysm was unavoidably entered. Hemorrhage was

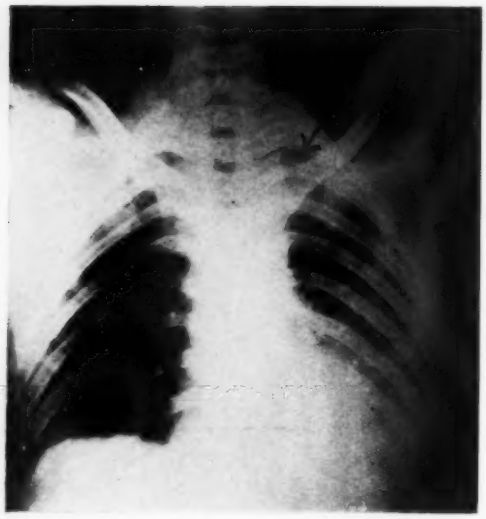

Fig. 3. Case III. Portable film obtained four days after automobile accident and evacuation of subdural hematoma, three days after hematemesis. Small amount of left pleural effusion. The patient was in shock. Rupture of the esophagus was suggested by the X-Ray Department.

controlled by Cushing clips and operation was discontinued. Postoperatively, at 10:00 P.M. on the same day, the patient's blood pressure suddenly dropped. He died fifteen hours later. A chest lesion was not suspected.

Postmortem examination confirmed the occurrence of subarachnoid hemorrhage and aneurysm of the right middle cerebral artery. When the chest was opened, 700 c.c. of dark-brown fluid was found in the right pleural space and 800 c.c. in the left. There was no mediastinal or cervical emphysema and no mediastinal fluid. Within the distal esophagus anteriorly, immediately above the diaphragm, were two vertical parallel linear tears measuring 5 cm. each. From these tears, dark fluid passed into the pleural spaces. The stomach was normal. A chronic duodenal ulcer was also found.

CASE III (Fig. 3): H. M. C., 16-year-old white male, was injured in an automobile accident four hours before admission to Grady Memorial Hospital on April 25, 1950. On admission, he was unconscious and responded poorly to all painful stimuli. Blood pressure was 175/80.

Roentgenograms of the skull showed no definite fracture. A craniotomy was done the same night and a large left parietal epidural hematoma was evacuated, with postoperative improvement. The following day the patient vomited a large amount of coffee-ground material. Because of sudden shock on April 29, a chest film was obtained, revealing a small amount of left pleural effusion and slight atelectasis. A presumptive diagnosis of ruptured esophagus was suggested by the senior resident in Radiology, Dr. Herbert Olnick, on the basis of the history and the left pleural effusion.

The patient's condition remained critical, the temperature gradually rose to 104° F., and death occurred on May 4, 1950.

Autopsy demonstrated multiple hemorrhages and contusions throughout the brain, a linear fracture of the left parietal bone, left epidural hematoma, and subarachnoid hemorrhage. The mediastinum, on the left side, was under marked tension, bulging into the left pleural space, in which were 200 c.c. of gastric contents. The right pleural space contained no fluid. In the left anterior wall of the esophagus was a vertical rent at the junction of the lower and middle thirds, measuring 3 cm. in length. The remainder of the gastro-intestinal tract was normal. The lungs were found to contain multiple infarctions.

CASE IV[4] (Fig. 4): F. M. J., 53-year-old white male, was transferred to Lawson Veterans Administration Hospital on July 1, 1949, for convalescent care. He gave a nine-year history of gradual weakness and unsteadiness of the lower extremities, with difficulty in joint position and inability to maintain balance in darkness. Four years previously, the same symptoms had appeared in the upper extremities. Otherwise, his health was good. A specific neurologic diagnosis was never established.

On the morning of Jan. 5, 1949, while dressing, the patient had suddenly experienced severe deep boring lower anterior chest pain. He "felt as though something inside had popped, and spit up a mouthful of bright red blood." The pain became intense, but vomiting never occurred. One hour before the onset of pain, he had had a black bowel movement.

He was admitted to Emory University Hospital where, clinically, his chest was reported clear. There was no palpable cervical emphysema. A chest film was described as "showing questionable air within the right side of the neck." Because of this, barium studies of the esophagus were done by Dr. Ted Leigh (Radiologist, Emory University Hospital), revealing extravasation of barium from the distal end of the esophagus into the mediastinum, with no pleural communication.

The diagnosis of spontaneous rupture of the esophagus was established and exploration was immediately undertaken by Dr. Osler Abbott. At operation, a linear vertical rupture of the esophagus measuring 0.5 cm. in length was found on the anterior wall 3 cm. above the diaphragm. The esophageal wall around the site of the rupture was necrotic. The left pleural space contained 200 c.c. of clear straw-colored fluid. There were hyperemia and edema of the lower mediastinum and cellulitis of the medial basilar segment of the left lower lobe.

[4] Presented through the courtesy of Dr. Osler Abbott, Asst. Prof. Clinical Surgery (Thoracic), Emory University Medical School; to be reported in fuller detail at a later date.

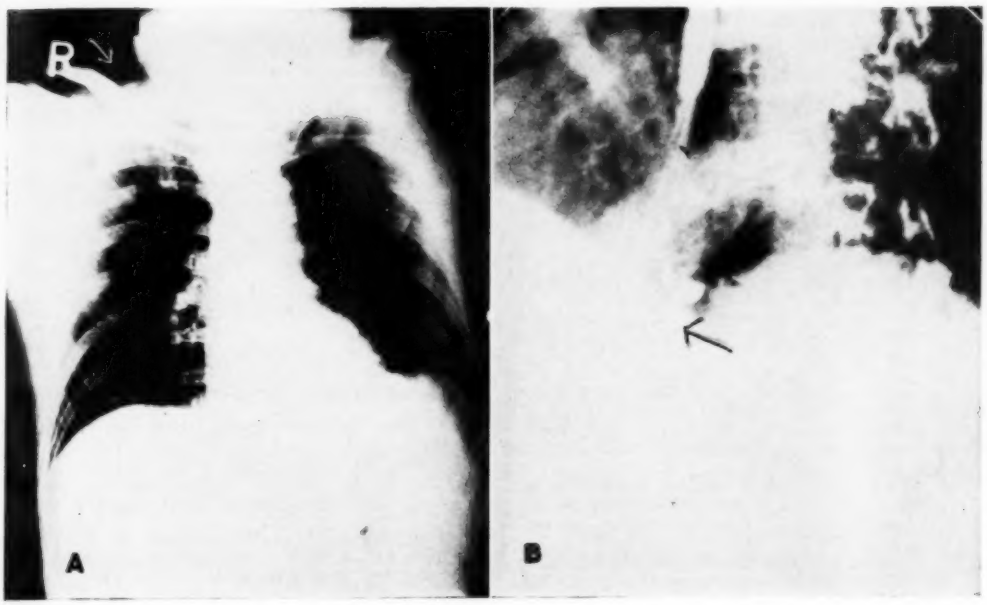

Fig. 4. Case IV. A. Chest film obtained on date of onset of illness, normal except for possible free air in soft tissues at base of neck.
B. Esophagram with barium, obtained one day after onset of illness, demonstrating an esophageal fistula originating in the lower 3 inches of the esophagus.

An 8-cm. longitudinal incision was made through the esophagus and cardia of the stomach and the necrotic areas were excised.

The postoperative course was stormy, despite various types of surgical and medical treatment. The patient was referred to Lawson Veterans Administration Hospital with a left esophago-pleurocutaneous fistula. Chest films on July 17, 1949, showed extensive left pleural calcification. The patient died Aug. 4, 1949. Autopsy findings will be reported by Dr. Abbott at a later date.

CASE V: A 60-year-old negro male, previously asymptomatic, had right-sided convulsions on the morning of Oct. 2, 1950, relapsing into coma three hours later. Examination on admission to Lawson Veterans Administration Hospital, on the same day, showed a blood pressure of 200/112, absence of reflexes in the right lower extremity, a white blood count of 30,000 with a shift to the left, spinal fluid pressure of 310 mm., the fluid itself being colorless, with a normal cell count.

The next day, while the patient was still in coma, he vomited a small amount of bloody material; on the basis of this, an ulceration of the upper gastrointestinal tract was suspected. Death ensued the following day. X-ray examination was not requested.

On postmortem examination, the brain showed extensive cerebral arteriosclerosis with encephalomalacia and regional petechiae.

On opening the chest cavity, a mass within the left side of the mediastinum was seen bulging into the left pleura. The mass was found to contain a green fluid. The esophagus showed a longitudinal perforation, measuring 1 cm., on the left side, anterior to and just above the cardia. This perforation communicated with the fluid within the mediastinum. There was no pleural involvement. The remaining portions of the gastro-intestinal tract were normal.

SUMMARY

1. The literature on spontaneous rupture of the esophagus has been reviewed. The pathological, clinical, and roentgen findings are presented.

2. Although the diagnosis of spontaneous rupture of the esophagus in some cases can be made on the history and clinical findings, roentgen examination is often needed for confirmation. At times, it may be the only means of establishing a diagnosis.

3. The most common roentgen findings in spontaneous rupture of the esophagus are hydrothorax, hydropneumothorax, mediastinal and neck emphysema, and demon-

stration of a fistula. Only the last two are specific.

4. Five cases are reported.

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SUMARIO

Rotura Espontánea del Esófago. Presentación de Cinco Casos

Después de repasar la literatura relativa a la rotura espontánea del esófago, preséntanse los hallazgos anatomopatológicos, clínicos y radiológicos.

Aunque cabe hacer en algunos casos el diagnóstico de rotura espontánea del esófago partiendo de la anamnesia y los hallazgos clínicos, a menudo se necesita el examen roentgenológico para confirmación. A veces, hasta puede ser el único medio de establecer el diagnóstico. Los hallazgos roentgenológicos más comunes consisten en hidrotórax, hidroneumotórax, enfisema mediastínico y cervical y presencia de una fístula. Sólo los dos últimos son específicos. Descríbense 5 casos.

Left Ascending Aorta with Right Arch and Right Descending Aorta[1]

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MOST OF THE ANOMALIES of the aorta have been carefully described, and the criteria for their diagnosis have been clearly delineated. It is the purpose of this paper to present a rare aortic anomaly which can be detected with ease by routine radiologic examination. The roentgen findings in this condition have not previously been described.

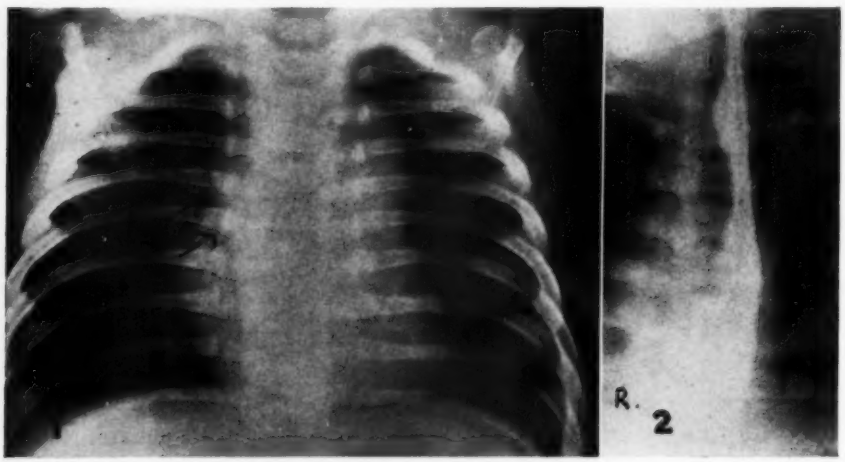

Fig. 1. Postero-anterior projection. Arrows point to the descending aorta on the right. The prominence in the left upper cardiovascular contour represents the ascending aorta. Note the relative avascularity of the lung fields.

Fig. 2. Spot film made during fluoroscopy in the postero-anterior projection. The right arch produces a smooth, curved impression on the right of the barium-filled esophagus at the level of the arch. This was constant at fluoroscopy.

CASE REPORT

P. G., a five-month-old white boy, was admitted to the hospital because of persistent cyanosis and increasing dyspnea. Intermittent cyanosis had developed one week after birth, and the condition had become sufficiently severe to necessitate continuous oxygen therapy.

Physical Examination: The child was small and underweight. Deep generalized cyanosis was present. The heart was normal to percussion, and no murmurs were heard. Coarse rhonchi were audible throughout the lungs. There was marked retraction of the upper abdominal wall. The liver was felt two fingerbreadths below the costal margin and did not pulsate. No clubbing was present.

Laboratory Findings: The hemoglobin level was 12 gm., and the red blood cell count was 4,200,000. The electrocardiogram showed marked right axis deviation.

Roentgen Examination: The lung fields were abnormally clear. In the postero-anterior projection, the heart appeared normal in size. At the left upper cardiovascular border was a pulsating bulge extending from the region of the pulmonary artery segment up to the point usually occupied by the aortic knob. The descending aorta was clearly delineated on the right (Fig. 1). On the barium esophagram, the esophagus was shown to be displaced to the left at the level of the aortic arch, indicating the presence of a right arch (Fig. 2). In the left anterior oblique view, no obvious chamber enlargement was demonstrated. The barium-filled esophagus was displaced posteriorly at the level of

[1] From the Department of Radiology, Stanford University School of Medicine, San Francisco, Calif. Accepted for publication in October 1950.

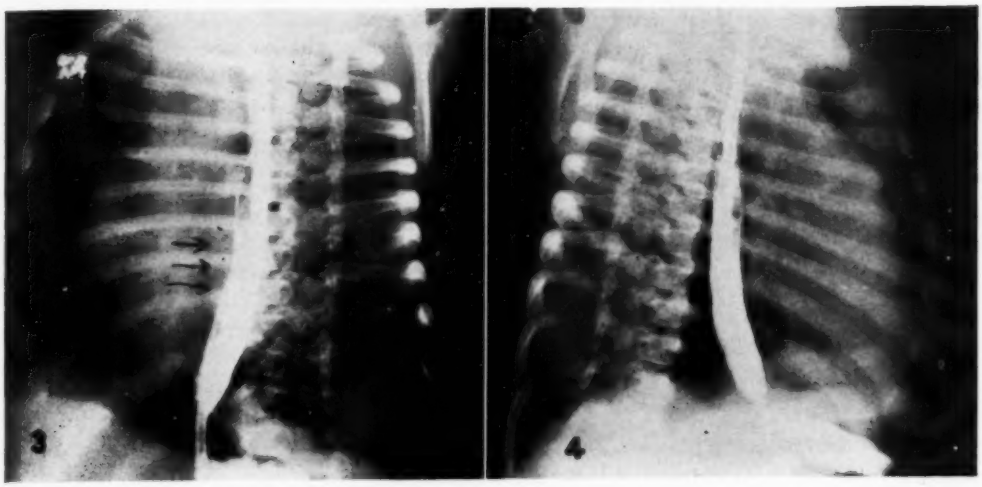

Fig. 3. Left anterior oblique view. Arrows point to the descending aorta, which is somewhat more anteriorly placed than is usual in this projection. No definite chamber enlargement is present.

Fig. 4. Right anterior oblique view. Note the fullness in the region usually occupied by the pulmonary artery. This represented the ascending aorta.

the aortic arch. The descending aorta was more anteriorly placed than is usual in this projection and overlapped the posterior cardiac border (Fig. 3). This constituted further evidence for a right descending aorta. There was some fullness at the usual site of the pulmonary artery in the right anterior oblique view (Fig. 4). In the lateral projection, the trachea was displaced posteriorly, apparently by a smooth vascular structure (Fig. 5).

These findings suggested the possibility that the aorta arose on the left, with the transverse portion of the arch crossing anterior to the trachea, and the descending aorta on the right. If this hypothesis were correct, the bulge at the usual site of the pulmonary artery, seen in both the postero-anterior and the right anterior oblique view, represented the ascending aorta. A vascular ring was also a possibility, although there was no evidence of impingement upon the esophagus posteriorly.

Because of the relatively avascular lung fields, it was assumed that there was diminished pulmonary arterial flow, and the presence of pulmonic stenosis of a high degree with an atrial septal defect was considered. A trilocular heart was also suggested and was specifically mentioned as one of the two alternative diagnoses in the original report. Findings compatible with a trilocular heart were: definite cyanosis in the absence of murmurs and a heart of normal size as seen in the postero-anterior projection, with no evidence of right ventricular or other chamber enlargement in the oblique views.

Course: Cyanosis and dyspnea persisted, with increasing severity, and the infant vomited most of his feedings. He died twelve days after admission.

Autopsy: The heart had three functioning chambers. Both auricles were normally formed and emptied into a single large ventricle. The mitral valve was hypoplastic. A rudimentary outlet chamber was present, from which a somewhat dilated aorta arose to the left of the midline. The transverse portion of the arch of the aorta crossed the midline anterior to the trachea, and the aorta descended on the right. The ductus arteriosus was

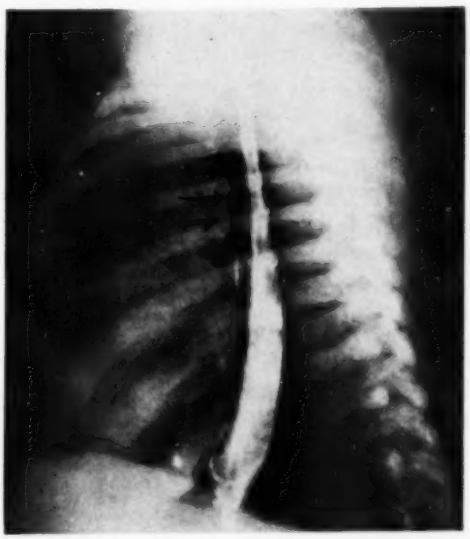

Fig. 5. Left lateral projection. Arrows point to the site of compression of the trachea by the transverse portion of the arch of the aorta as it crosses anteriorly.

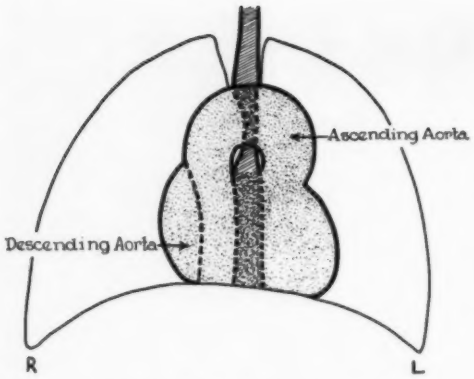

Fig. 6. Diagrammatic representation of the course of the aorta. The barium-filled esophagus is cross-hatched, while the heart and aorta are stippled.

patent and communicated with the right and left pulmonary arteries. The main pulmonary artery was represented by an atretic band which extended from the ventricle to the point of junction of the ductus arteriosus with the right and left pulmonary arteries.

DISCUSSION

The Nature of the Anomaly: Anomalies of the aorta have been the subject of recent comprehensive discussion (6, 12) and there is no need of an additional review here. Edwards (6) has summarized and illustrated the anomalies of the aortic arch thus far reported in the literature, and has described some additional theoretical possibilities. In all of these anomalies, the ascending portion of the arch arose to the right of the midpoint of the esophagus, the multiple variations being related to differences in position or structure of the transverse portion or descending aorta, or in the position of the vessels arising from these portions.

The anomaly recorded in this paper differs fundamentally from those hitherto described in that the ascending portion of the arch arose on the left. The transverse portion crossed to the right anterior to the trachea, and the aorta descended on the right (Fig. 6). Superficially, one might consider this similar to the "left aortic arch with right descending aorta" recently reported by Paul (14). But in his cases, as well as in the case reported by Edwards (5), the ascending portion of the arch arose normally to the right of the esophagus. The transverse portion coursed to the left of the esophagus and then posterior to it, with the descending aorta on the right.

As far as can be determined, the roentgen findings in the anomaly described here have not previously been reported. The reason for this becomes apparent when the explanation for the anomaly is considered. The rudimentary ventricle is thought to be the developmental remnant of the bulbus cordis, from which the infundibulum of the right ventricle is normally formed (16). In order for the aorta to arise from this rudimentary chamber, it must be transposed (1). Cases in the literature with a single ventricle and a rudimentary outlet chamber are few in number. Favorite found 7 cases reported up to 1934 (7), and added a case of his own. Since then, 8 additional cases have been published (4, 8, 11, 13, 15, 16). Taussig reported a case very similar to ours; not only did a relatively large aorta arise from the rudimentary ventricle, but the pulmonary artery was atretic as well. The course of the aorta was not stated in her case. In none of the cases reviewed was the aorta described as descending on the right (4, 7, 8, 10, 11, 13, 15, 16, 17).

Because the maldevelopment of the bulbus cordis and the failure of normal torsion of the root of the aorta are the main factors producing this anomaly, it should be clearly distinguished from the anomalies of the aortic arch. Although it is true that maldevelopment of the primitive aortic arches contributed to the findings in so far as there was a right aortic arch, it had nothing to do with the origin of the aorta on the left.

A few cases of complete transposition of the great vessels have recently been described in which the aorta, arising from the infundibulum of the right ventricle, was farther to the left than is usually the case in transposition of the great vessels (2, 3, 9). In these cases, the ascending aorta filled the position in the left upper cardiac border usually occupied by the pulmonary artery.

The aorta descended on the right in one of these cases, but no description was given of the relationship of the transverse portion of the arch to the trachea and esophagus. In the remaining cases, the aortic arch was to the left of the esophagus, as was the descending aorta.

Diagnosis: The criteria for the diagnosis of a left ascending aorta with right arch and right descending aorta are as follows:

(1) A right descending aorta as seen on the postero-anterior roentgenogram.
(2) A right arch, as shown by its impression on the right of the barium-filled esophagus at the level of the aortic arch.
(3) A vascular structure (the transverse portion of the arch) anterior to the trachea, demonstrated in the lateral projection.
(4) Absence of a vascular structure posterior to the esophagus, as shown by absence of anterior displacement of the barium-filled esophagus.
(5) A pulsating contour of the left upper cardiovascular silhouette, extending up to the usual position of the aortic knob.

The above findings are characteristic and establish the diagnosis. In the differential diagnosis, the following anomalies must be considered and excluded:

(1) Right aortic arch with right descending aorta. There is no anterior compression of the trachea at the level of the arch.
(2) Right aortic arch with left descending aorta. There is no anterior compression and there is posterior impingement upon the barium-filled esophagus.
(3) Vascular ring with right descending aorta. Posterior compression of the esophagus is present.
(4) Left aortic arch with right descending aorta. The characteristic findings of a right arch are absent and the esophagus is anteriorly displaced.
(5) Left ascending aorta with left arch and left descending aorta (transposition of the aorta). Although the aorta arises on the left, there is no evidence of a right arch. The transverse portion of the arch does not pass anterior to the trachea.

SUMMARY

A case of left ascending aorta with right arch and right descending aorta is described. The nature of the anomaly is briefly discussed, and the criteria for diagnosis and for the differentiation of other anomalies are outlined.

NOTE: Dr. Robert Alway, of the Department of Pediatrics of the Stanford University School of Medicine, permitted and encouraged the report of this case.

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SUMARIO

Aorta Ascendente Izquierda con Cayado Derecho y Aorta Descendente Derecha

La rara anomalía aórtica aquí descrita es fácil de observar en los corrientes exámenes roentgenológicos. El enfermo era un niñito de cinco meses. La porción ascendente del cayado de la aorta tiene su origen a la izquierda, la porción transversal cruza hacia la derecha en frente de la tráquea y la aorta descendente está a la derecha. Las pautas para el diagnóstico radiológico son las siguientes. (1) Aorta descendente derecha observada en la radiografía postero-anterior; (2) cayado derecho, según revela la impresión a la derecha del esófago lleno de bario a la altura del cayado de la aorta; (3) tejido vascular (la porción transversal del cayado) en frente de la tráquea, observado en la proyección lateral; (4) ausencia de tejido vascular detrás del esófago, según revela la ausencia de desplazamiento anterior del esófago lleno de bario; (5) contorno pulsátil de la porción superior izquierda de la silueta cardiovascular, extendiéndose hasta la habitual posición del nudo aórtico.

Chronic Intermittent Arteriomesenteric Occlusion of the Duodenum[1]

JEROME ROMAGOSA, M.D.,[2] AND LEON J. MENVILLE, M.D.[3]

IT HAS BEEN RECOGNIZED for over one hundred years that the root of the mesentery of the small intestine could produce chronic intermittent obstruction of the transverse duodenum. This condition was first suggested by von Rokitansky (1) in 1849, and many reports appeared in the medical literature soon after the turn of the century. Bloodgood (2) in 1907 clearly described the clinical course and pathologic findings in two patients whom he followed to autopsy. He also proposed a definitive form of surgical therapy, duodenojejunostomy, which is still employed in selected cases with good results.

Arteriomesenteric occlusion is characterized by a delay in passage of the bolus through the transverse duodenum due to compression of that structure by the spine and aorta posteriorly and the root of the mesentery, consisting of the mesenteric artery, vein, and nerve, anteriorly. This condition is most likely to occur in asthenic individuals with lordosis and visceroptosis. Acute episodes are frequently precipitated by a sudden loss of weight. This may initiate a vicious cycle of further weight loss as nutrition is interfered with by the obstruction. The most common symptoms observed in these patients are nausea, epigastric pain, vomiting, and headaches. Vasomotor disturbances may also occur. Careful questioning frequently reveals that the condition has existed from childhood. It occurs more frequently in females. Some cases have been diagnosed and treated as gastro-intestinal psychoneuroses.

Roentgen examination includes fluoroscopy and radiography as usually employed in examinations of the gastro-intestinal tract. A six-hour gastric residue is observed at times, but is by no means a constant finding. There may be varying degrees of duodenal obstruction, which is usually intermittent. The site of obstruction appears sharp and linear on the radiograph of the barium-filled duodenum. The proximal duodenum may at times be enormously dilated. In some patients, however, where the pylorus is patent, there is no dilatation. In this instance the barium mixture is returned to the stomach by strong reversed peristaltic waves. In one of the cases to be reported here, it was observed at fluoroscopic examination that each reversal of peristalsis was accompanied by nausea. The duodenal obstruction may be temporarily relieved during fluoroscopy by having the patient assume the knee-chest position, or by upward pressure on the lower abdomen in the erect position (Hayes' maneuver) (3).

It should be appreciated that conditions such as adhesions, bands, tumors, malrotation of the gut, etc., may produce duodenal stasis or ileus. But Bockus (4) states that arteriomesenteric occlusion is the most frequent cause.

CASE REPORTS

CASE I: The 27-year-old wife of a physician gave an eight-year history of abdominal distress following meals. The symptoms varied from mild upper abdominal fullness to colicky pain. Relief was sometimes obtained by assuming the knee-chest position.

The patient was of asthenic habitus, and the only abnormal finding on physical examination was ptosis of the right kidney, which was considered by medical attendants as a possible cause of the symptoms.

A gastro-intestinal study on May 17, 1948, revealed a temporary obstruction at the junction of the second and third portions of the duodenum with ballooning and reversed peristalsis proximal to the point of obstruction (Figs. 1 and 2). There was no six-hour gastric residue. The obstruction was relieved during fluoroscopy by placing the patient in the knee-chest position.

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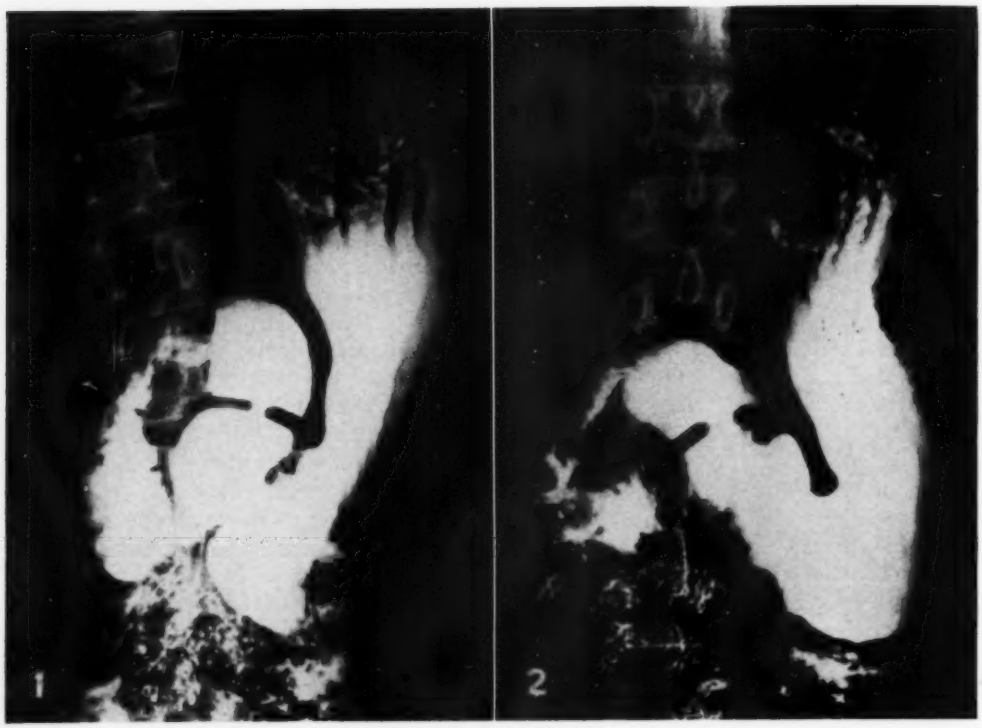
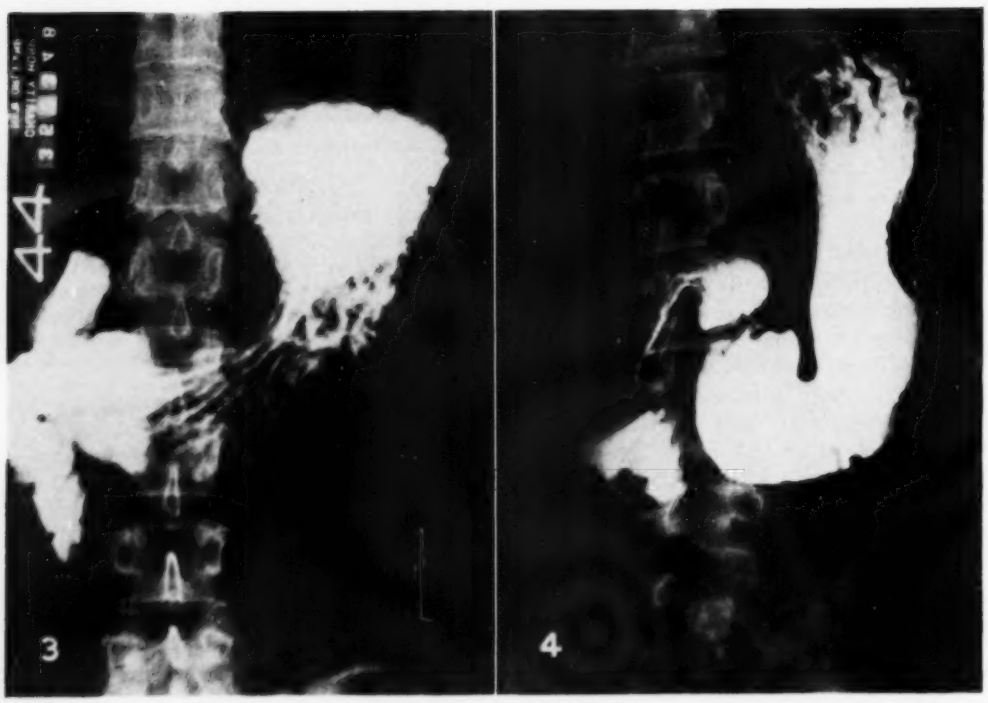


Figs. 1 and 2. Case I.



Figs. 3 and 4. Case II.

Following a duodenojejunostomy, on May 24, 1948, the patient has remained asymptomatic.

CASE II: A 24-year-old white female nurse had been suffering from intermittent cramping periumbilical pains for the past three or four years. Recently her weight dropped from 103 to 89 pounds. The weight loss was accompanied by an increased severity of symptoms.

Physical examination on April 9, 1950, revealed an asthenic individual with moderate lordosis. She was poorly nourished and appeared chronically ill. A gastro-intestinal series demonstrated intermittent occlusion of the transverse duodenum (Figs. 3 and 4) which could be temporarily relieved by Hayes' maneuver. There were strong reversed peristaltic waves which pushed the bolus back into the stomach through a patent pylorus. Intermittent bouts of nausea accompanied the reversed peristalsis as observed fluoroscopically.

Conservative treatment, consisting of bed rest, positional exercises, and a high vitamin, high caloric diet, was employed with no improvement.

At the time of surgical exploration the proximal duodenum was opened. The surgeon placed his finger in the duodenum and noted obstruction in the transverse portion from extrinsic pressure by the root of the mesentery. A duodenojejunostomy was performed and the patient has remained asymptomatic and gained weight since the operation.

These two cases have been reported to emphasize the importance of keeping this condition in mind. Unless the duodenal loop is studied in its entirety at the time of fluoroscopy, the diagnosis may be overlooked.

Although arteriomesenteric occlusion of the duodenum is infrequent, it is of the utmost importance that it be recognized by the radiologist, since the roentgen examination is of the chief significance in establishing diagnosis.

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SUMARIO

Oclusión Arteriomesentérica Intermitente Crónica del Duodeno

Los 2 casos descritos son de oclusión del duodeno debida a compresión por la raíz del mesenterio. En esos casos la obstrucción suele ser intermitente, mostrando la radiografía el asiento de aquella en forma aguda y lineal. Puede que no esté dilatada la porción proximal del duodeno. En ese caso la mezcla de bario es devuelta al estómago por poderosas ondas retroperistálticas. El tratamiento es por la duodenoyeyunostomía.

El examen roentgenológico reviste importancia primordial para el diagnóstico, y el estudio roentgenoscópico del asa duodenal en toda su extension es indispensable.

Duodenum Inversum

A Report of Two Cases[1]

EDWARD C. ROZEK, M.D., and CHARLES M. GRANEY, M.D.

Batavia, N. Y.

DUODENUM INVERSUM is a rare congenital anomaly of the intestinal tract in which the normal curve of the duodenum is reversed so that the third portion, instead of turning to the left, crossing the midline and forming the duodenojejunal junction, turns to the right and takes an upward course, curving then to the left and crossing the midline above the pancreas. The designation is not applicable to the left-sided duodenum of situs inversus.

Duodenum inversum is of relatively rare occurrence, although reports are appearing in the literature with increasing frequency. Addison (1) reported the discovery of 1 case in 100 consecutive anatomical dissections. Feldman and Morrison (16) found 14 instances in 20,000 gastro-intestinal x-ray examinations, an incidence of 0.07 per cent. Weinbren and McGregor (44), in 1934, reviewed the literature and estimated that the cases recorded up to that time numbered about 30. This included 11 of their own, 10 reported by Sandera (35), 5 by Hürthle (24), and several single cases. In the same year, Breton (9) and Bernay (5) each reported a case. Feldman and Morrison added their 14 cases, mentioned above, in 1940, and in the same year Fallon (15) described an example discovered in the course of an anatomical dissection. Töndury (39) recorded 5 cases in 1941. The most recent example which we found in the literature is that of von Bonin (41) in 1944. The purpose of this paper is to present 2 additional cases, bringing the total to approximately 55.[2]

Duodenum inversum is believed to be due to persistence of the dorsal mesentery with a mobile duodenum, and is often accompanied by anomalies in fixation or position of the right kidney, pancreas, and transverse mesocolon. Good discussions of the embryological aspects are found in the articles by Weinbren and McGregor, Feldman and Morrison, and Fallon.

The reported cases show a predominance of males, about 3 or 4 to 1 female. The anomaly may be found at any age, the average being about forty-six. The range in 24 reported cases was from twenty-six to seventy years.

SYMPTOMATOLOGY

Duodenum inversum is frequently asymptomatic. The commonest symptom is epigastric pain or discomfort; nausea, belching, gaseous distention, and dyspeptic symptoms are frequently encountered. Jaundice and diarrhea are often present concomitantly. Loss of weight, "bilious" attacks, anorexia, and migraine headaches may occur. Pancreatitis, gallbladder disease, duodenal ulcer, and, less commonly, gastric ulcer may be associated. Many of the symptoms are thought to be due to stasis in the duodenal loop.

The diagnosis is commonly made by x-ray examination. The condition may be encountered, however, during surgery or at autopsy. Symptoms are usually relieved by conservative treatment, including rest, diet, and other methods commonly used in gastroenterologic practice.

RADIOLOGIC ASPECTS

Duodenum inversum is rarely suspected clinically. The diagnosis is usually made during fluoroscopy and subsequent radiography. Proper evaluation of the status of the duodenum is important in all gastro-

[1] From the Departments of Radiology and Surgery, St. Jerome Hospital, Batavia, N. Y. Accepted for publication in November 1950.

[2] Since the submission of this paper for publication, a further case has come to the attention of the authors: Sheehan and Kelley: Irish J. M. Sc., pp. 288-292, June 1950. Abst. in Radiology **56:** 770, 1951.

intestinal studies, inasmuch as such conditions as diverticula, duodenitis, mucosal distortion at the ampulla of Vater, ulcerations, and other pathological findings can readily be overlooked. The normal duodenal C-curve should be studied rou-

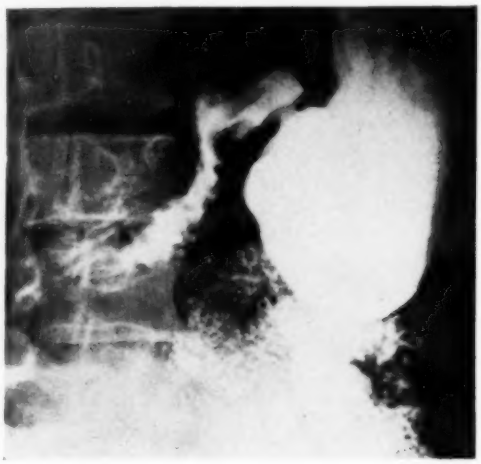

Fig. 1. Duodenum inversum: Case I

tinely, as this may offer evidence not only of a lesion in the duodenum but also of disease of the pancreas, biliary tract, and occasionally the abdominal cavity.

Feldman and Morrison in 1940 classified duodenum inversum as of four types. The two cases described below are of their second type, *i.e.*, the bulb and second portion of the duodenum were normal in position, while the third part, instead of curving to the left and extending across the spine, curved to the right and somewhat posteriorly, then proceeded upward to a point above the level of the bulb, whence it passed to the left and downward, dipping inferiorly behind the stomach to join the jejunum. The distal portion was thus considerably longer than under normal conditions. In each case the lumen of the entire duodenum appeared to be slightly larger than usual. Peristalsis was also somewhat more active. The passage of the barium through the duodenum also appeared to fit in with Sandera's three functional radiological signs,

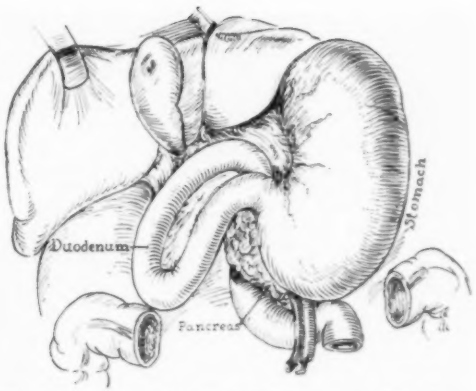

Fig. 2. Case I. Artist's sketch from x-ray film, showing position of duodenum

showing evidence of reverse peristalsis with some delay in the abnormal lower curve and finally rapid passage through the third stage, apparently due to well-developed peristalsis.

Radiographically there were no signs of any other gastro-intestinal anomaly in these cases.

CASE REPORTS

CASE I: A 43-year-old farmer was seen in the office with a history of upper abdominal pain coming on at about five o'clock in the afternoon, for the past month. This was usually but not always relieved by the evening meal. A diagnosis of possible duodenal ulcer was made and the patient was placed on antispasmodics and antacids. He failed to improve on this regime and after about three weeks was given a gallbladder diet and bile salts. Following two or three weeks of this treatment, without improvement, a gastro-intestinal x-ray series was performed.

The report was in part as follows: Barium flows freely into the stomach, which is normal in size and position. The rugal pattern is within normal limits. Peristalsis is somewhat hypoactive. The duodenal bulb fills well, is not deformed, and shows no evidence of ulcers. The duodenal sweep, however, is the reverse of that which is normally seen, with the second and third portions of the duodenum passing over to the right side of the abdomen instead of to the left. This anatomical anomaly may result in some stasis in the duodenum, causing a duodenitis. No ulcer crater is noted. The remaining small bowel pattern appears normal.

The diagnosis was duodenum inversum.

Following this examination, the patient was again placed on an ulcer regime. Improvement followed, with relief of pain in the course of the next month or two. He has not been seen since that time.

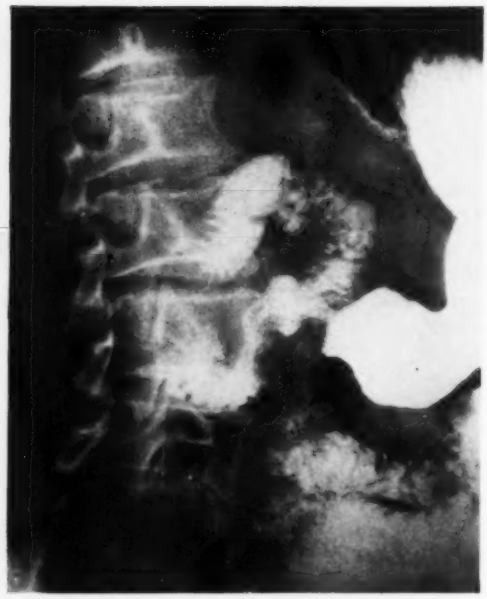

Fig. 3. Duodenum inversum: Case II

CASE II: A 69-year-old male, employed as a stationary engineer, was a patient of Dr. Seldon T. Williams, of Attica, New York, through whose courtesy this case is being reported. The patient gave a history of stomach trouble, off and on, all his life and of recurrent upper abdominal pain, apparently of an ulcer type, during the past two months. In addition he had experienced several attacks of agonizing epigastric and upper abdominal pain. He was referred for a gastro-intestinal series on Feb. 16, 1950. The report in part was as follows.

"The stomach is somewhat fish-hook in configuration. The rugal pattern is somewhat atrophic and no evidence of gastric ulceration is noted. The duodenal bulb is somewhat spastic and does not fill completely but there is no evidence of any ulcer crater. This deformity is apparently due to a duodenitis. The duodenal sweep is reversed and there exists a congenital deformity known as duodenum inversum. The small bowel mucosal pattern does not appear unusual. Some hypomotility is present.

"*Conclusion:* Duodenum inversum with some duodenitis. The deformity in the duodenum is apparently due to duodenitis, but the bulb should be rechecked after antispasmodic treatment, inasmuch as a shallow ulcer crater may be present."

The patient still remains under observation and is following an ulcer regime and treatment with antacids and antispasmodics. He has experienced considerable relief of pain and appears to be doing well.

SUMMARY

Duodenum inversum is a rare developmental anomaly in which the normal curve of the duodenum is reversed. The incidence was found to be 0.07 per cent in one series of 20,000 gastro-intestinal x-ray examinations. The authors report 2 cases, bringing the total number in the literature to about 55.

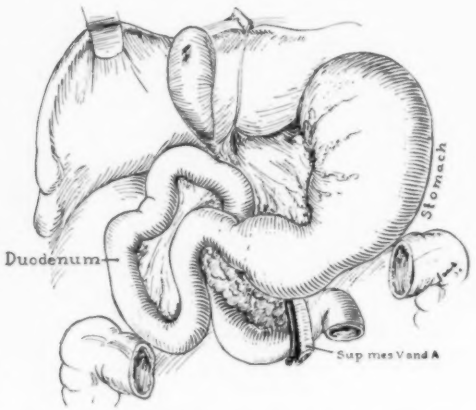

Fig. 4. Case II. Artist's sketch from x-ray film, showing position of duodenum

The symptoms are suggestive of ulcer, pancreatitis, or gallbladder disease. The diagnosis is usually made roentgenologically.

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SUMARIO

Duodeno Invertido. Presentación de Dos Casos

El duodenum inversum constituye un raro vicio del desarrollo en el cual se halla invertida la curva normal del duodeno. La incidencia del mismo ha resultado ser de 0.07 por ciento en una serie de 20,000 exámenes gastrointestinales con los rayos X. Los AA. comunican 2 casos, elevando así a unos 55 el número total descrito.

Los síntomas son indicativos de úlcera, pancreatitis o colecistopatía. El diagnóstico suele hacerse roentgenológicamente.

En los casos de los AA., la tercera porción del duodeno se encorvaba hacia la derecha y algo hacia atrás, prosiguiendo hacia arriba hasta un punto más arriba del nivel del bulbo, y luego pasaba a la izquierda y hacia abajo, hundiéndose allí detrás del estómago para unirse al yeyuno. La porción distal se hallaba considerablemente alargada y la luz de todo el duodeno parecía ser ligeramente mayor de lo acostumbrado. El paso del bario indicó antiperistaltismo con alguna demora en la anormal curva inferior y por fin paso rápido por la tercer etapa, debido aparentemente a un peristaltismo bien desarrollado.

Microradiography

Its Application to the Study of the Vascular Anatomy of Certain Organs of the Rabbit[1]

WALLACE S. TIRMAN, M.D., CHARLES E. CAYLOR, B.S., HARRY W. BANKER, M.D., and TRUMAN E. CAYLOR, M.D.

MICRORADIOGRAPHY may be defined as that branch of radiology which deals with the production and study of roentgenograms of thin sections of tissue. The quality of these microroentgenograms is such that they may be magnified many diameters and may be examined under the microscope without significant loss of detail. The purpose of this paper is to present the normal microradiographic appearances of the vascular pattern of several rabbit organs.

MATERIALS AND METHODS

The procedure used in our work is essentially that developed by Barclay (3) with slight modifications. We use 10 per cent silver iodide with 3 per cent acacia as the injection medium. The rabbit is anesthetized with nembutal given intravenously, supplemented by inhalation ether anesthesia whenever necessary. A catheter is inserted into the aorta at its bifurcation and placed so that the tip lies at the opening of the vessel to be filled, as, for example, the renal artery or superior mesenteric artery. If specimens of the heart and lungs are desired, the catheter is inserted into the superior vena cava or right atrium through one of the neck veins. The types of catheter used include a No. 4 ureteral catheter, Garceau catheter, and a No. 9 urinary catheter.

The dye is injected under controlled pressures of 50 mm. of mercury for the superior vena cava and 150 mm. of mercury for the aorta. When the organ is seen to be grossly well filled, the injection is stopped and a clamp or tie is placed about the artery and veins. The organ is then removed and fixed with formalin without sectioning. A series of roentgenograms is first obtained with the usual diagnostic x-ray apparatus, to determine the most satisfactory plane and site for sectioning. Sections of 200 to 300 microns are then cut by frozen section technic. The section is mounted between two layers of Stryafoil,[2] a very thin radiolucent membrane resembling cellophane in appearance. The top layer of Stryafoil prevents evaporation and drying during the x-ray procedure, and the bottom one separates the specimen from the emulsion of the film.

The need for x-rays of long wave length led Barclay to choose a diffraction type of x-ray apparatus. This had a beryllium window, since an ordinary glass type of tube would absorb too many of the long-wave x-rays. Our apparatus is of a similar type except that the tube has a chromium target. It is provided with two beryllium windows. Attached to the tube are brass cylinders 6 and 8 inches long and 2 inches in diameter. The plate holder is constructed of cast aluminum with a brass bottom (3/8 inch thick). The x-ray tube is set up in a horizontal position, so that the beam is vertical in distribution, and in such a way that one window is at the bottom of the tube, and one at the top. The upper one is covered with a piece of lead. This prevents the scattering of radiation about the room, while the heavy brass cylinders and brass in the plate holder prevent the escape of any significant amount of x-rays from the lower opening or from the apparatus. The factors commonly employed are 20 kv., 12 ma., 6 to 8 inches distance. The time of exposure is from fifteen minutes to two or three hours.

The emulsion found to be the most satisfactory was Kodak spectroscopic plate

[1] From the Caylor-Nickel Clinic, Bluffton, Ind. Accepted for publication in December 1950.
[2] Obtained from B.X. Plastics, London, England.

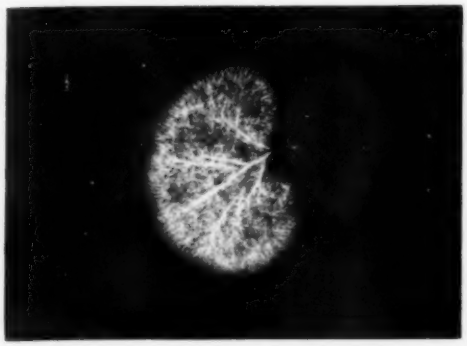


Fig. 1. Rabbit kidney, normal size, after injection of 10 per cent silver iodide with 3 per cent acacia.

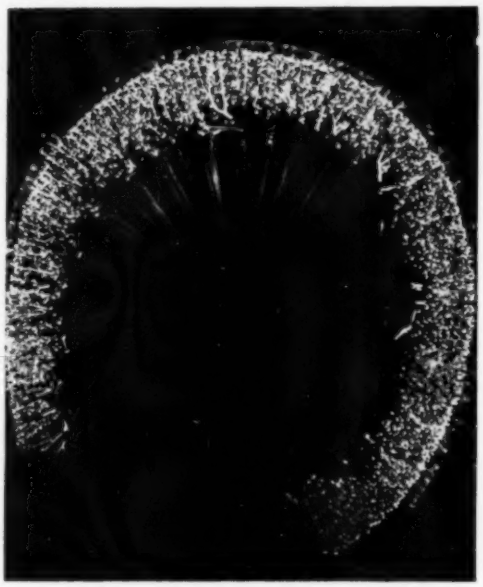


Fig. 2. Cross section (300μ) of kidney at the pelvis. ×3.

548-0 or 649-GH. Although we use glass plates, these emulsions may be obtained, also, in ordinary cut film. The 548-0 has a resolution power of 500 lines and the 649-GH of 1,000 lines. Roentgenograms taken on these plates can be magnified up to 300 to 500 times without visible grain effect, for microscopic study.

To obtain enlargements, photomicrographs were taken of the microradiographs. A 5× or 20× objective was used together with a 5× ocular. Further enlargement

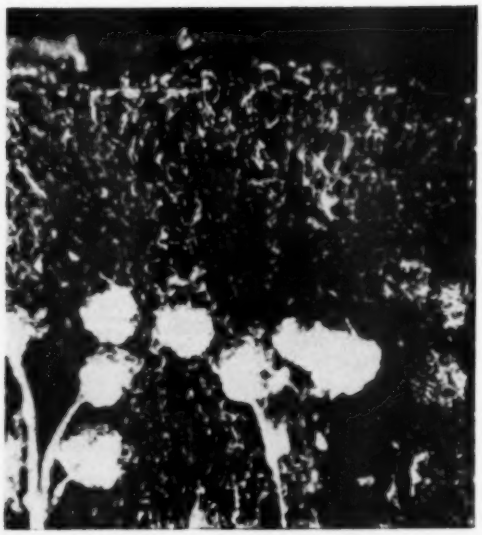


Fig. 3. Section of kidney (300μ) at the peripheral part of the cortex. Note lack of glomeruli in the cortex corticis. There is a prominent subcortical network. ×50.

was accomplished by use of a photographic enlarger.

RESULTS

The microradiographs included in this paper demonstrate the vascular patterns of various rabbit organs.

Kidney: The kidney was injected through a catheter in the aorta at the level of the renal artery. The injected kidney at normal size is shown in Figure 1. A cross section through the mid-portion of the kidney (300μ) enlarged ×3 demonstrates (Fig. 2) the pattern of the cortex and medulla. The cortex corticis, a peripheral zone containing no glomeruli, shows a rather intense capillary network. The arrangement of the glomeruli and arterioles in the cortex is demonstrated. There is a radial arrangement of the vasa recta in the medulla. Further enlargement of the cortex and medulla is shown in Figures 3, 4, and 5. Considerable difficulty was experienced in obtaining satisfactory filling of the efferent vessels of the glomeruli until we used a preliminary injection of nitroglycerin, gr. 1/100 (Fig. 5). High-power magnification (×250) of

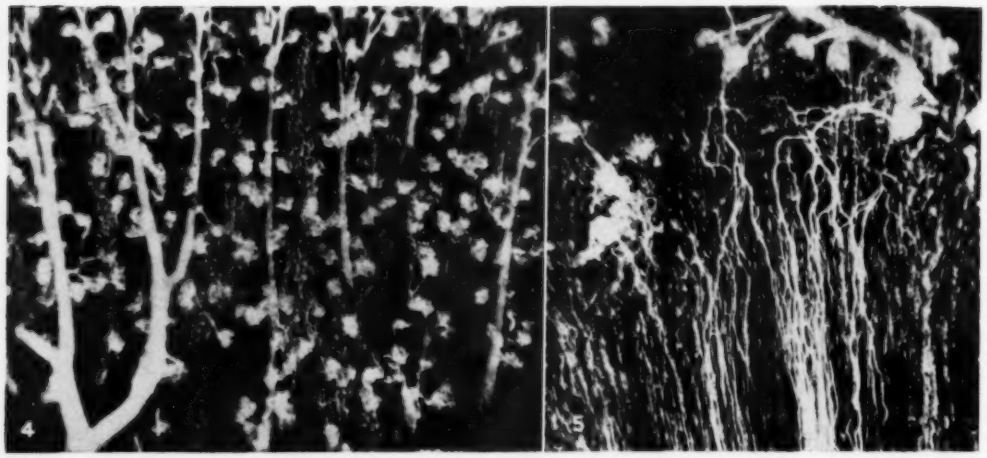


Fig. 4. Section of kidney (300μ) at mid-portion of cortex. ×25.
Fig. 5. Section of kidney (300μ) including parts of the medulla and the juxta-medullary part of the cortex. Note filling of afferent and efferent vessels (after nitroglycerin). ×25.

a glomerulus and its efferent and afferent vessel is shown in Figure 6. Figure 7 is a microradiograph at low power (×40) of a transverse cut across the vasa recta. These vessels apparently are arranged in circular patterns. The smaller vessels within the circles probably supply the individual tubules.

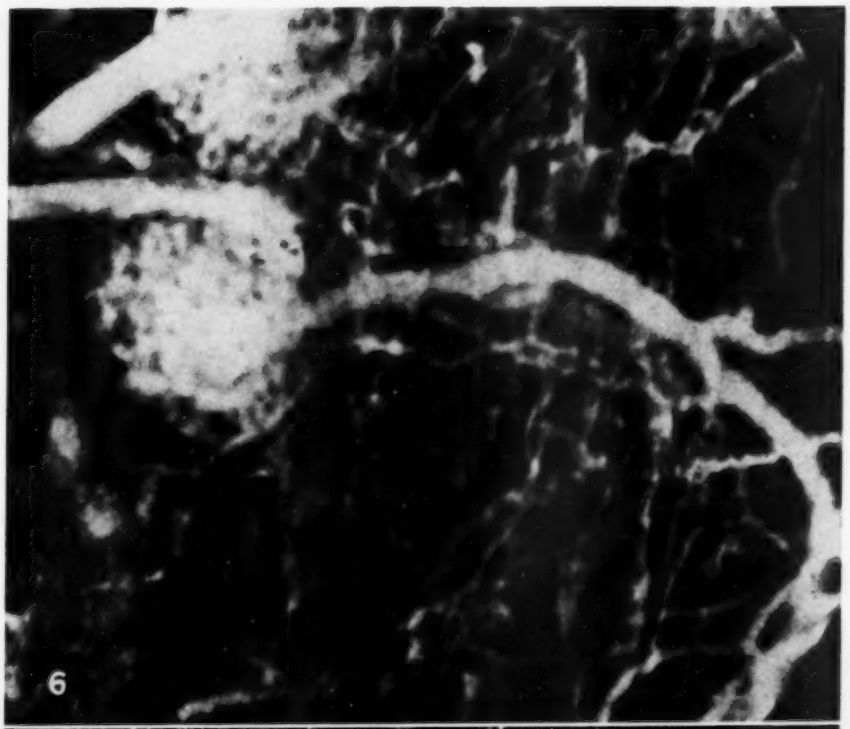
Small Intestine: A vertical arrangement of the vessels in the mucosa and submucosa was shown in injected specimens of the upper duodenum (Figs. 8 and 9). It was difficult to distinguish the junction of the mucosa and submucosa by their vascular patterns, even when the microradiographs were compared with hematoxylin and eosin slides. Many loops of capillaries are seen at or near the surface of the specimen. The capillaries are seen to extend toward the surface of the mucosa and then turn back toward the mucosa. Many of the vessels increase in caliber at these loops.

Vascular rings have been described at the surface of the mucosa of the stomach. These are more clearly demonstrated in a microradiograph, full thickness, laid flat, such as is presented later in the description of the gallbladder. Occasional loops are also seen below the surface of mucosa, probably lying in the submucosa. These are reminiscent of the loops in the vasa recta of the kidney described by Trueta, Barclay *et al.* (5). Vascular networks in the muscularis and serosa are also demonstrated, but these are not as well filled.

Gallbladder: A network of large vessels is seen in the microradiograph (Fig. 10) of the entire thickness of the gallbladder wall, laid flat. These probably represent vessels in the muscular coat. There is, in addition, a network of smaller vessels (Fig. 11), presenting many ring-shaped formations, resembling those described by Woolf (1) and believed by him to represent vascular rings about the mouths of the glands.

Liver: The liver was injected through a catheter introduced into the aorta, so that the opening lay at the level of the celiac axis. The dye entered the liver through the hepatic arteries. Some dye also reached it through the portal vein *via* the mesenteric arteries. Since the dye reached the liver *via* the portal vein and hepatic artery, the lobules are well filled at the periphery (Fig. 12). There is less dye in the central part of the lobules, and none in the central veins. The enlargement (×175) shows numerous sinusoids (Fig. 13), with abundant anastomoses.

Heart: The heart was filled from the right side with a catheter in the superior



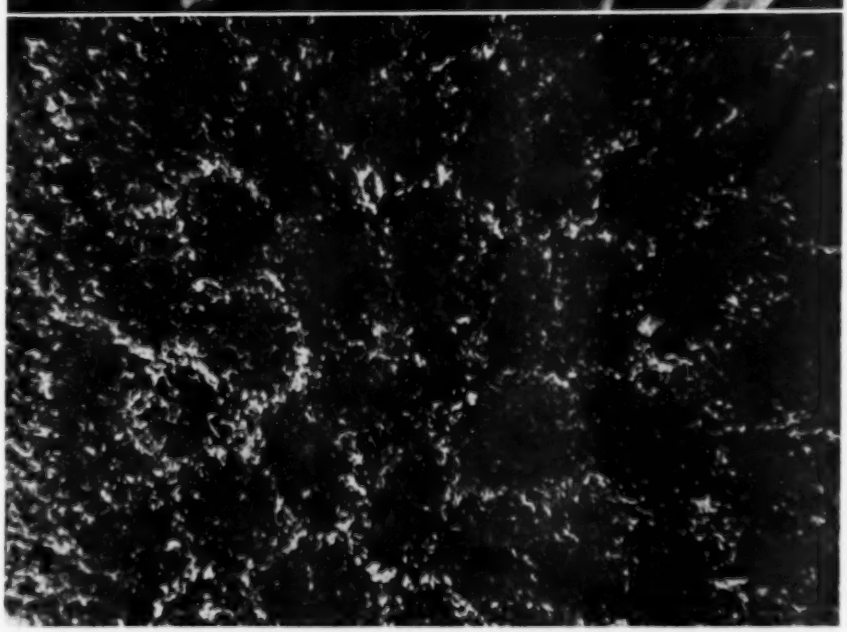
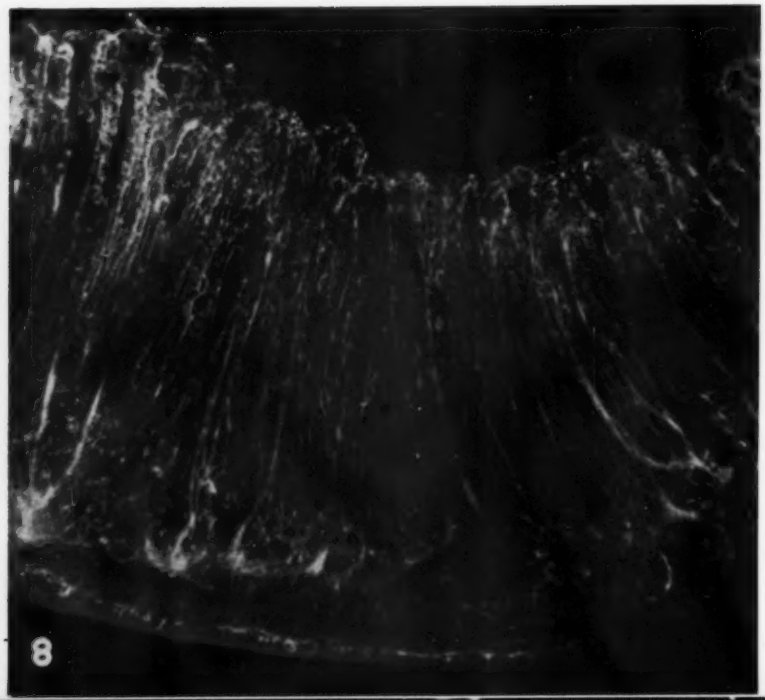


Fig. 6. Section of kidney (300μ). Further enlargement of glomerulus illustrating afferent and efferent vessels. The efferent vessel is on the right. ×250.

Fig. 7. Section of kidney (300μ). Cross section of some of the vasa recta, showing arrangement around tubules. ×40.



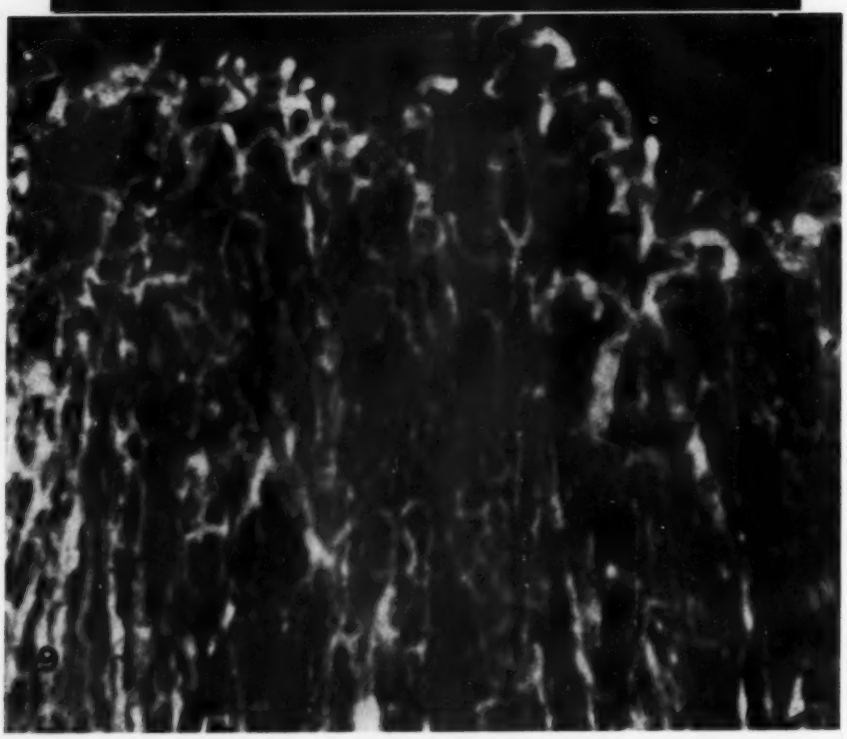


Fig. 8. Cross section (300μ) of wall of duodenum. ×45.
Fig. 9. Further magnification of specimen in Fig. 8. ×180.

vena cava. Adequate filling could also be obtained through the left side of the heart with a catheter in the aorta. However, the blood in the right side replaced the dye before the heart stopped beating. If a head of pressure was kept up in the catheter in the aorta to such a degree that the left ventricle remained filled with dye, the heart gradually became so dilated that very little dye was found in the myocardial vessels on section. A cross section of the heart near the apex, showing the right and left ventricle, demonstrates a rather unusual pattern (Fig. 14). First, the amount of dye present in the vascular channels is so great that it presents an almost solid density. There is apparently considerably more dye present than in the liver or kidney. These blocks of increased density seem to follow a trabecular pattern and it is to be noted that in this cross section, as in many others that we took, there is a peculiar lack of arterioles or other vessels, except the smallest capillaries.

When the higher magnifications are studied (Fig. 15), it is seen that the trabecular patterns consist of minute capillaries. The appearance suggests that each muscle cell must be surrounded by a capillary network. Certainly the vascular supply of the myocardium is greater by far than of any of the other organs studied.

Spleen: The pattern of the splenic circulation as revealed by microradiography differs from that of any of the organs described above (Fig. 16). The arterioles are demonstrated in the white pulp. The smaller vessels which are filled probably represent the arteries of the pulp, the sheathed arteries, and the arterial capillaries. The white pulp surrounds the vessels. Encircling the white pulp is a prominent concentration of dye in the red pulp which is almost ring-shaped in distribution. The dye in the red pulp does not present an organized pattern. In some areas small conglomerate collections of dye are present; in other areas faint traces of dye. When one considers that the section is of the same thickness as that of the other organs described, it is surprising how

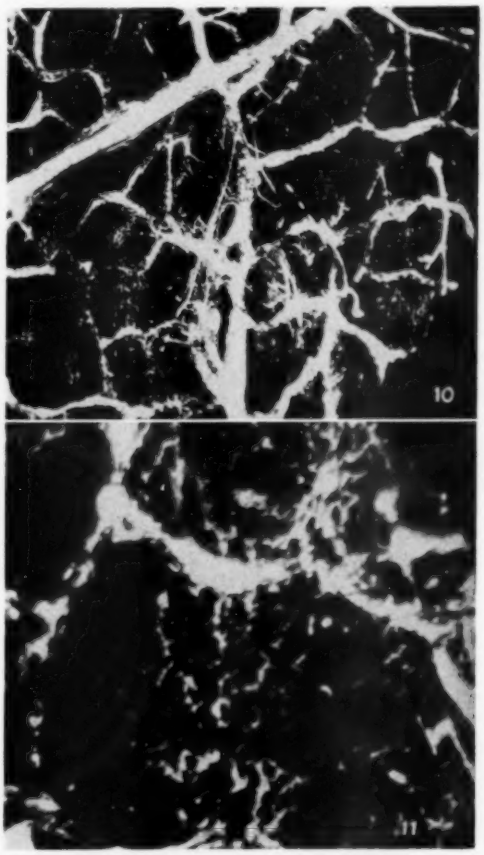
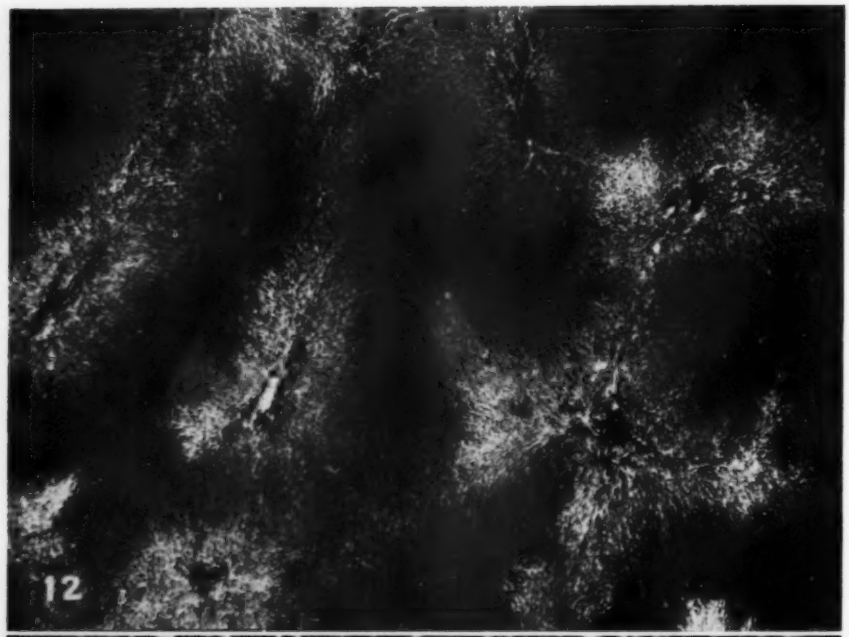


Fig. 10. Full thickness of wall of gallbladder. Note networks of large and small vessels. ×25.
Fig. 11. Same specimen as in Fig. 10. Note ring-shaped vascular outlines. ×100.

little dye the spleen contains as compared to some of these, particularly the heart. It is, of course, quite possible that the spleen may have been contracted at the time of its removal. It was removed intact, however, along with the stomach, liver, and other organs of the upper abdomen, in one block, and fixed before sectioning.

Numerous black dots are seen in the dye pattern in the higher magnification (Fig. 17). It was thought at first that these might represent red blood cells, but vessels of other organs, such as the kidney, failed to show a similar pattern. Several possibilities are to be considered. One is that those black dots may be free macrophages,



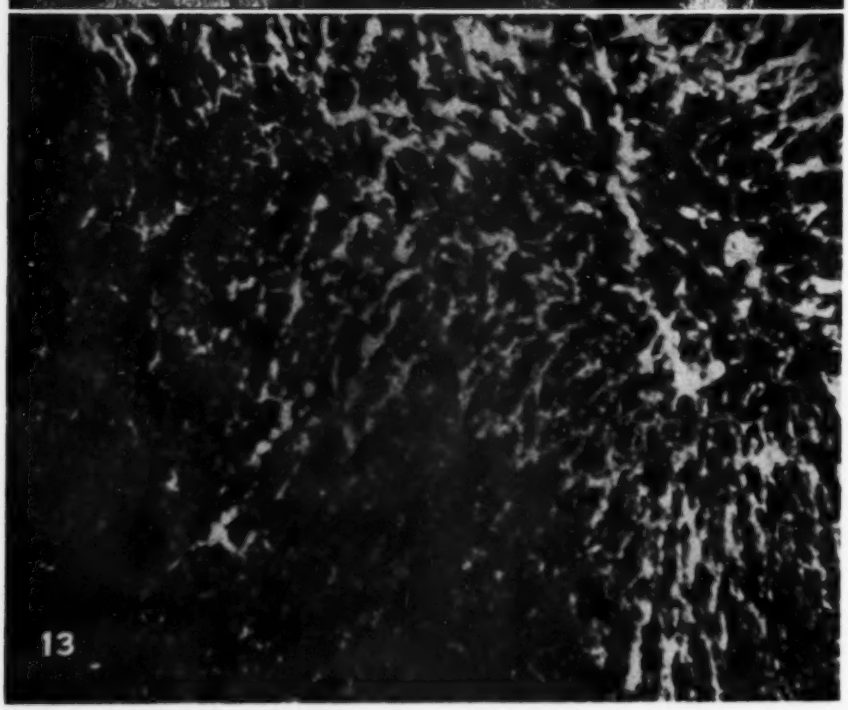


Fig. 12. Section of liver (300μ). Note that the periportal regions are better filled than the center of the lobules. The central veins contain no dye, and appear black. ×40.
Fig. 13. Further enlargement of specimen in Fig. 12. The central vein appears as a darker area in the lower left corner. ×175.

or large lymphocytes, in an open circulation type of pattern. Or it may be that they represent the spaces between the capillaries in a network of smaller vessels, resembling the mesh of a closed circulation similar to that described by Miller (8) in the lung. We have as yet made no attempt to obtain evidence *pro* or *con* in the open- or closed-circulation argument. This problem, we feel, could be investigated to advantage by microradiography.

Lung: In studying the microradiographs of the parenchyma of the lung, it must be remembered that the sections are considerably thicker than the usual microscopic sections, averaging usually about 300μ. Many more structures are therefore included in each section. The larger circular areas of decreased density represent air in the bronchioles and possibly in some of the veins. These are seen best in the lower magnification, reproduced in Figure 18. In this same illustration the dye presents ring-shaped shadows of increased density. We believe these represent the alveoli. Higher magnification (Fig. 19) demonstrates a background pattern that may be interpreted as consisting of a network or mesh of capillaries of variable size with small black dots between them representing the tissue not occupied by the capillaries.

The pattern of circulation seen in the microradiographs of the lung did not show the usual vascular anastomoses seen in other organs such as the heart, kidney, and intestine, but looked much like that seen in the spleen. It is worthy of note that the dye seems to be distributed in groups of alveoli, suggesting that it represents a lobular distribution of the branches of the pulmonary artery.

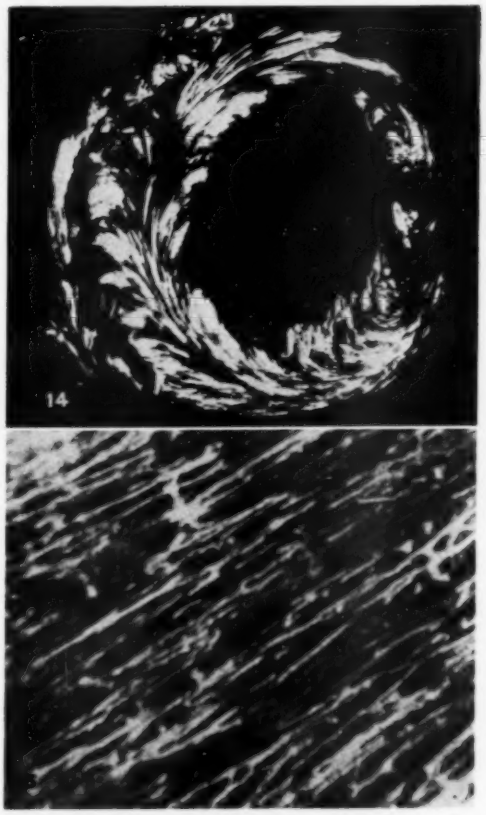
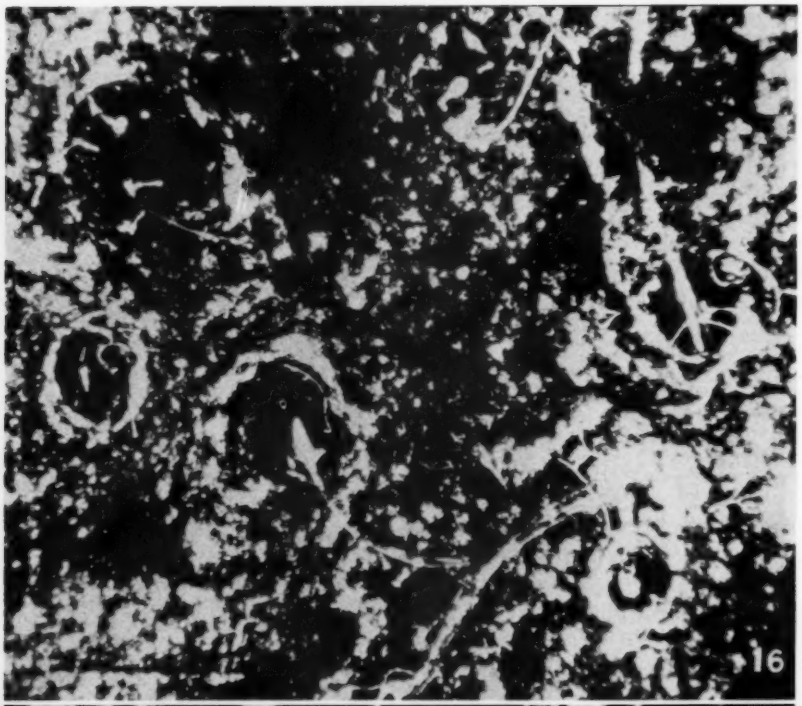


Fig. 14. Cross section of entire heart (300μ). The left ventricle lies on the right. ×3.
Fig. 15. Same specimen as in Fig. 14. Note marked anastomosis of capillaries. ×150.

DISCUSSION AND SUMMARY

The use of x-rays in the microscopic study of vascular and histologic patterns opens a whole new field of investigation. The technic devised by Barclay is the least complicated of those available and permits relatively easy production of microradiographs.

Reynolds (2), in an editorial in the *American Journal of Roentgenology*, makes the following statement: "One of America's greatest physiologists in commenting on Barclay's studies in which he employed microradiography says that he thinks 'the technique is one of the greatest milestones in medical science.'" Certainly it makes possible studies which may be of value in the field of anatomy, histology, pharmacology, physiology, and medicine. Barclay himself, with his co-workers (3–5), investigated some physiological reactions of the kidney and stomach of rabbits by means of microradiography and demonstrated the presence of a vascular shunt in these organs. Lamarque (6) studied



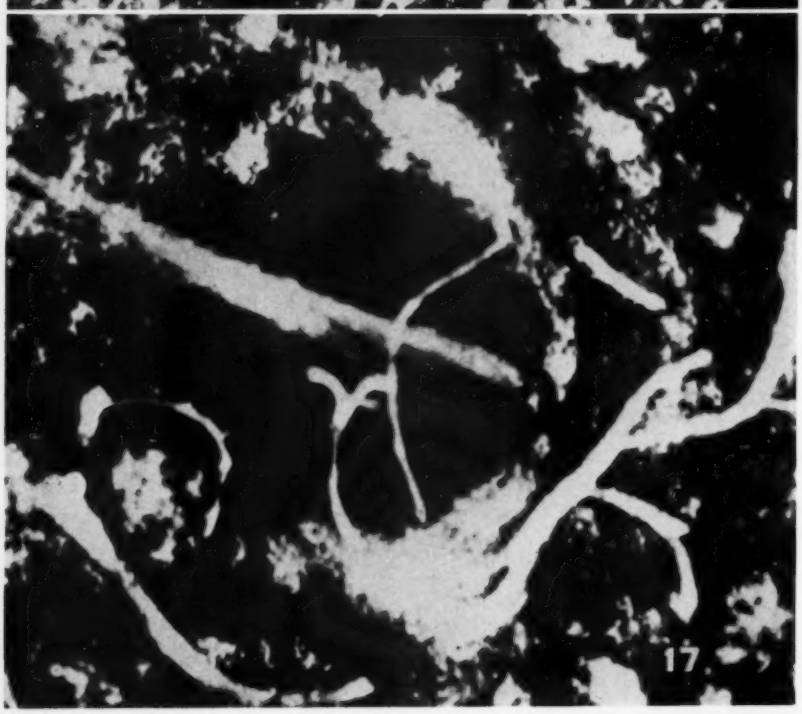
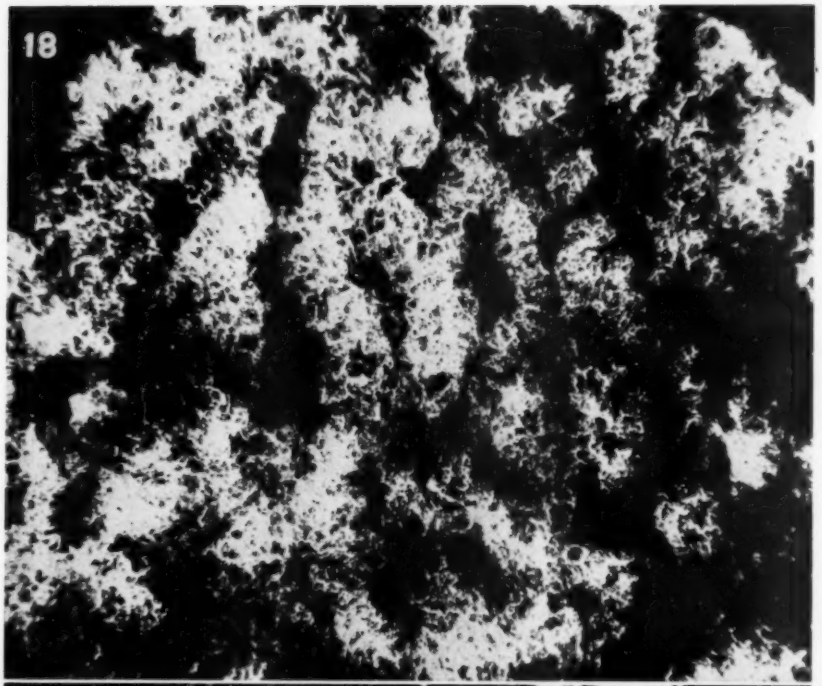


Fig. 16. Section of spleen (300μ). The white pulp contains the larger vessels, and is roughly circular in shape. The vessels demonstrated are probably the penicilli. The red pulp shows a relatively unorganized pattern. ×40.

Fig. 17. Same specimen as in Fig. 16. A vessel is seen surrounded by white pulp. The pattern of vascular filling in the red pulp is different than in the white pulp. ×160.



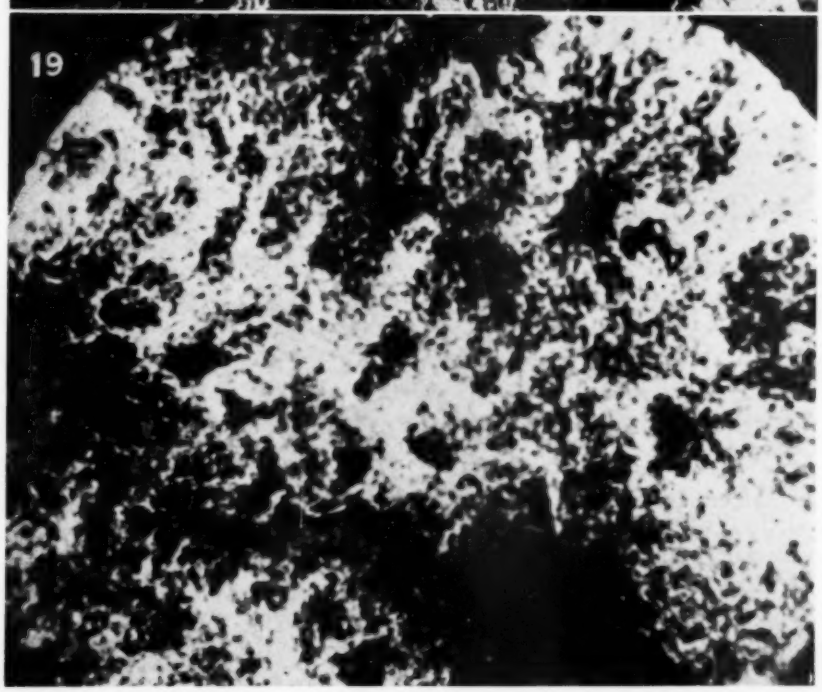


Fig. 18. Section of lung (300μ). Note rings of increased density which probably represent alveoli. ×40.

Fig. 19. Same specimen as in Fig. 18. Vascular pattern resembles that seen in the red pulp of the spleen. Capillary anastomosis in the alveolar wall is demonstrated. ×160.

the microscopic structures of cells without the use of a radiopaque medium, using his own technic of microradiography. Bohatyrtschuk (7) also devised his own technic, which he employed in investigation of some physiological and pharmacological aspects of the blood vessels of certain organs. Others have also carried out investigations in this special field, but the three outstanding workers are those just named.

We have attempted to establish a normal microradiographic pattern of several rabbit organs. Some of the patterns found are unusual and may suggest answers to problems of histology that have been unsolved by other methods of investigation. In the spleen, for example, the microradiographic pattern suggests that the circulation in the red pulp is relatively less organized than that demonstrated in other organs. We believe that this approach to microscopic study of tissue may be of help in determining the true nature of the splenic circulation. The abundance of vascular channels in the heart, so much greater than in any of the other organs studied, was amazing to us. In the kidney a surprising observation was the lack of filling of efferent glomerular vessels in spite of the excellent filling of the vasa recta. We have undertaken an investigation of the action of several drugs in the kidney, and have been able to demonstrate excellent filling of some of the efferent vessels following the injection of 1/100 gr. of nitroglycerine (Fig. 5).

CONCLUSION

The use of x-rays in the study of microscopic structures is relatively new, and much work needs to be done to determine its value. We have presented the microscopic patterns of several rabbit organs in an attempt to establish a normal pattern for the organs. The vascular patterns of the kidney, duodenum, gallbladder, liver, heart, and spleen have been described and illustrated.

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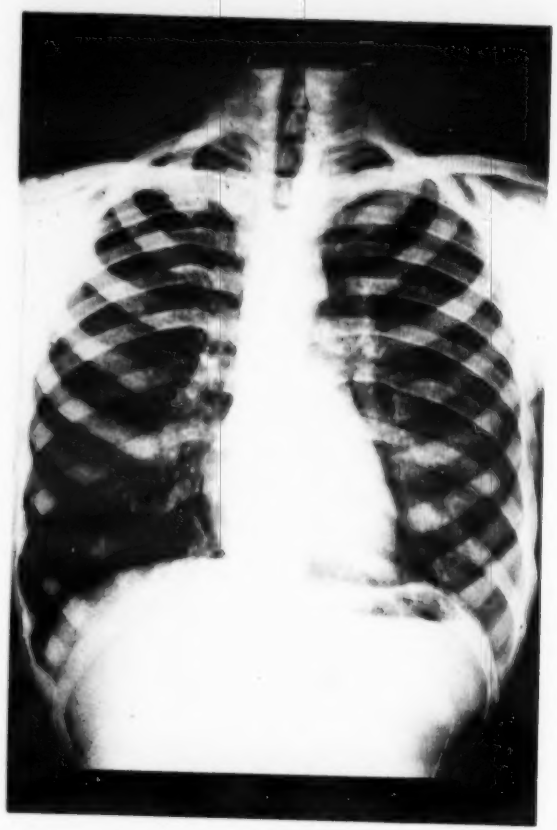
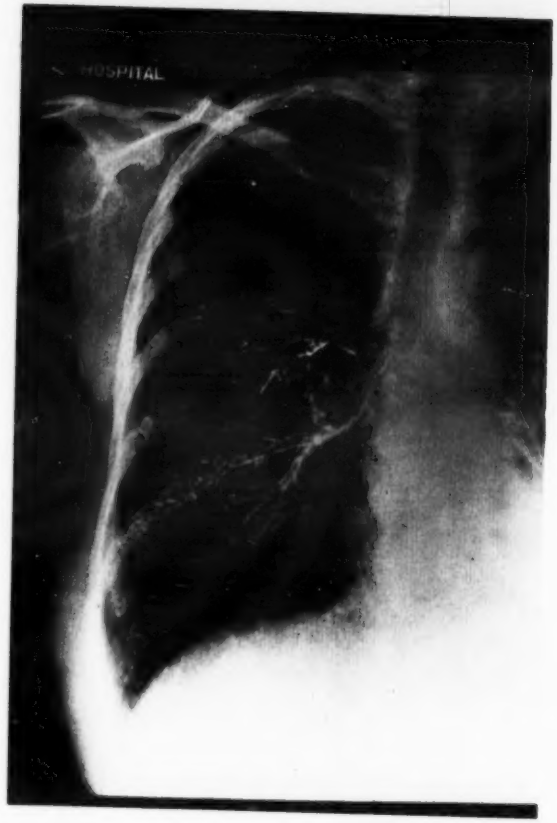
SUMARIO

La Microrradiografía: Su Aplicación al Estudio de la Anatomía Vascular de Ciertos Organos del Conejo

La técnica microrradiográfica de Barclay (véase Am. J. Roentgenol. 61: 1, 1948) ha sido ligeramente modificada y aplicada al estudio de los patrones vasculares del riñón, duodeno, vesícula biliar, hígado, corazón y bazo del conejo.

El empleo de los rayos X para el estudio de tejidos microscópicos es relativamente nuevo, y resta mucho por hacer antes de poder valuarlo debidamente. No obstante, parece entreabrir todo un nuevo campo de investigación.




HOSPITAL

Color as a Teaching Aid for Diagnostic Roentgenology[1]

EVERETT L. PIRKEY, M.D.,[2] JAMES E. PARKER, JR., A.B.,[3] and FRANK W. SHOOK, B.P.A.[4]

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THE INADEQUACIES of present day methods of teaching the undergraduate have repeatedly been brought home to us. This is particularly apparent during informal discussions with a few students, when one finds all too frequently that they have failed to correlate their knowledge of gross anatomy, pathology, and physical diagnosis with the different densities recorded on a roentgenogram as explained in the formal lectures.

In an effort to bridge this gap in our large groups (90–95 students), we have tried various methods, such as drawings, photographs, chalk talks, simultaneous showing of normal and abnormal films, and others. None seemed to solve the problem completely, and we have continually been on the search for a relatively simple method that would give life to roentgenograms.

The ideal would permit the student to feel as though he were looking at a transparent three-dimensional patient, with each type of tissue in a different color. With such material, it is felt that there would be an automatic correlation of other teachings with the deposition of silver granules on a film.

In 1949, an unusual photographic process was introduced to permit commercial photographers to produce colored pictures from ordinary black and white negatives. This is used principally for pictures where the ideal lighting necessary for color cannot be obtained, as for sport shots. It occurred to one of the authors that the adoption of this process might prove to be of value in teaching.

No attempt will be made here to describe in detail the individual steps necessary, but in a general manner the procedure is as follows:

1. An ordinary photographic negative of the original roentgenogram is made.
2. This negative is then printed, either by contact or projection, on flexichrome film.
3. The flexichrome film is developed in the recommended manner.
4. Following this development and the stopbath, the film is placed in moderately hot water, where the gelatin is melted from the emulsion in inverse ratio to the amount of reduced silver granules per unit volume of the emulsion. This results in a bas-relief image, with the emulsion thickest in the dark areas and thinnest in the light areas of the flexichrome film.
5. After drying, the print is ready for coloring with the recommended dyes.

The amount of dye absorbed in a given area will be determined by the thickness of the emulsion and therefore will automatically reproduce the shading found in the original roentgenogram.

Unique properties of these dyes make the

Plate I (left). Normal chest film, colored to show the approximate location of the lobes of the lungs *in vivo* as viewed from the anterior aspect. The right upper lobe is red, the right middle lobe is purple, the right lower lobe is blue, the left upper lobe is green, and the left lower lobe is yellow.

Plate II (right). Normal bronchogram of the right lung. The right upper lobe bronchi are in red, the right middle lobe bronchi are in lavender, and the right lower lobe bronchi are in blue.

[1] From the Departments of Radiology and Visual Education, University of Louisville School of Medicine. Aided in part by a grant from the Kentucky State Medical Research Commission. Originally presented as an Exhibit at the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10–15, 1950.

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actual coloring simple, for one dye may be painted over another and will absorb the former color. The relief image produces all the shading needed, as well as accurately delineating the structures one from another. A minimum of artistic talent is needed, the principal requirement being a sense of color balance.

The illustrations shown are representative of the expected results. The flexichrome prints, after coloring, are photographed on 35-mm. color film, and the films, following processing, are bound and used as slides for most of the teaching.

From our experience in showing some of this material to laymen, medical students, and physicians who are not radiologists, we can say that in every case information has been imparted that we have not found possible to make clear by other means.

In conclusion, we recommend further exploration of the use of color as an additional aid in the teaching of diagnostic roentgenology.

NOTE: We wish to extend our appreciation to the Medical Division of the Eastman Kodak Company, manufacturers of flexichrome materials, and particularly to George Struck and Lou Gibson of that division.

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Plate III (above). Paranasal sinuses. The frontal sinuses are red, the ethmoidal areas are green, and the maxillary sinuses are purple.

Plate IV (below). Retrograde pyelogram, showing large polycystic kidneys in red. The calyces, pelves, and ureters are in blue.

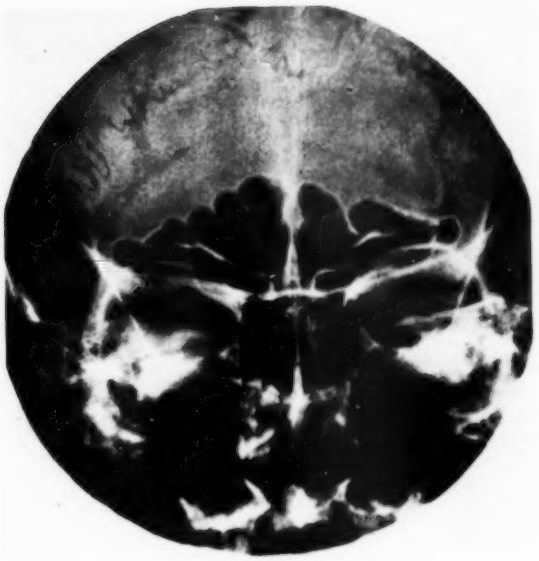
SUMARIO

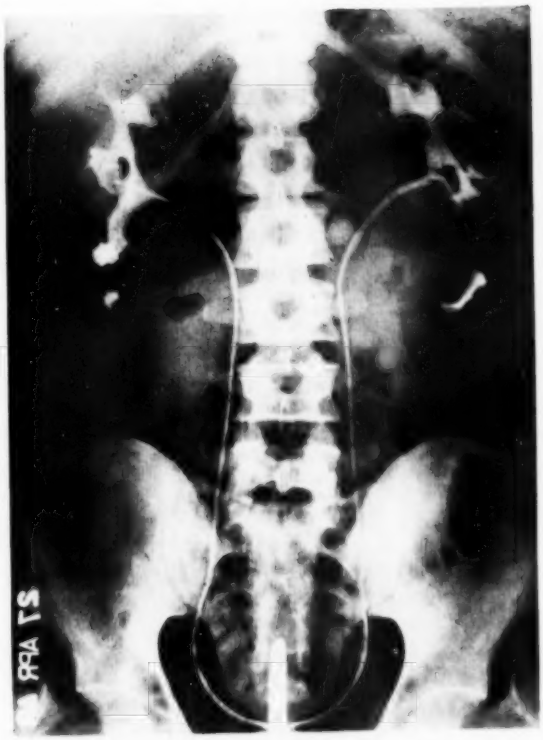
El Color como Auxiliar Didáctico en la Roentgenología de Diagnóstico

Con mira a correlacionar, para fines de enseñanza, los hallazgos roentgenográficos con la anatomía macroscópica, la anatomía patológica y el diagnóstico físico, se ha utilizado un procedimiento fotográfico destinado primitivamente a la reprodución en colores de negativas blanco-negras con propósitos comerciales.

Se imprime una negativa fotográfica de la radiografía primitiva ya por contacto o proyección en una película flexicrómica, que luego se revela en la forma acostumbrada. Después del revelado y del baño fijador, se coloca la película en agua moderadamente caliente, para fundir la gelatina de la emulsión en razón inversa a la proporción de gránulos de plata reducida por volumen unitario de la emulsión. Esto da por resultado una imagen en bajo relieve, siendo la emulsión más espesa en las zonas oscuras y más delgada en las zonas claras de la película. Una vez seca, la película está dispuesta para la aplicación de los colorantes recomendados para el caso. La cantidad de colorante absorbido en una zona dada será determinada por el espesor de la emulsión y reproducirá por consiguiente el sombreado de la radiografía primitiva.

Las impresiones flexiformes teñidas son fotografiadas en películas crómicas de 35 mm. y las películas acabadas son encuadernadas y usadas como placas en la enseñanza.




APR 17

Dependence of the Human Skin Reaction Produced by Ionizing Radiation Upon the Type of Radiation

Some Speculations[1]

C. W. WILSON, M.Sc., Ph.D., F. Inst. P.

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IT IS WELL KNOWN that the dose of radiation required to produce a specified skin reaction in man depends upon the wave length. From time to time various hypotheses have been advanced in explanation of this fact, but none of these can be said to be completely satisfactory.

Gray (3) and Read (7) have suggested that the reaction of the human skin to radiation may have its basic cause in the production of chromosome abnormalities. If this hypothesis is correct, as the evidence put forward by these authors seems to indicate, it should be possible to predict on this basis the kind of dosage variation with radiation quality that is known to hold for skin reactions; and this for variation not only in wave length of roentgen rays but also in type of radiation.

It has been suggested (1) that it is not possible to specify whether the skin reaction is due to changes in epidermal cells or to vascular changes; that the transient reactions, such as erythema, are dependent upon the dose rate and are attributable primarily to vascular damage; that the permanent changes, such as atrophy of the skin, are due in part to vascular effects (telangiectases, etc.) and perhaps in part to chromosome abnormalities, although it is considered that the evidence for the latter is not convincing. The further suggestion has been made that in specialized cells, that is epidermal cells which have no potency for any alternative differentiation, only some of the genes may be required for life and for maintenance of function, etc.; thus even very striking chromosome abnormalities may not necessarily be proof of biological harm resulting in the observed skin reactions.

In spite of these discouraging observations, we have thought it worth while to put on record some speculations regarding the relation between the human skin reaction and the kind of radiation producing it. They may at least stimulate thought and possibly experimental work on the subject, while the data on which they are based may be useful in the consideration of the interaction between ionizing radiations and other living material.

The speculations presented below are based on the assumption that the human skin reaction to ionizing radiation has its basic cause in the production of chromosome abnormalities arising from chromosome breakage.

PHYSICAL BASIS OF THE PRODUCTION OF CHROMOSOME ABNORMALITIES

A satisfactory account of the production of chromosome abnormalities in *Tradescantia* has been given by Lea and Catcheside (4) in terms of initial breaks produced in the chromosomes or chromatids as the result of an ionizing particle passing through or close to the locus of the break. Other things being equal, the number of breaks produced may be taken as a measure of the biological damage (in the form of chromosome aberration) produced by the radiation. To effect the break, the ionizing particle must have a sufficient ion density (ions per micron of path). Thus the number of breaks is a function not only of the number of ionizing particles but also of their ion density. In comparing the effects produced by different radiations, most emphasis has been put upon this latter factor (2, 7). We have chosen to concentrate upon the number of effective

[1] From the Physics Department, Westminster Hospital, London, S.W.1., England. Accepted for publication in October 1950.

particles, or, more accurately, upon the effective path lengths of the particles in terms of their ability to produce chromosome breakage.

Although the theory has been tested only by means of observations on *Tradescantia*, we have assumed that it may be applicable also to the production of chromosome abnormalities in the cells which are presumed to be affected in the production of the skin reaction.

Lea and Catcheside showed that the number of primary breaks per roentgen produced in a chromatid may be expressed as $NA(L - 2r)$, where N is the number of electrons liberated per unit volume per roentgen, A is the area presented by the chromatid to the radiation, $2r$ is the mean path of the electrons in the chromatid of radius r, and L is the length of electron track (which occurs at the end of its range) over which the ion density is sufficient to produce breakage. They also showed the number of isochromatid breaks per roentgen to be equal to $1/2 \times 0.165 NA(L - 4r)$, the factor $1/2 \times 0.165$ allowing for the probability that particles which break a specific chromatid will also break the sister chromatid.

Lea and Catcheside also concluded that in *Tradescantia*, where the mean path in each chromatid is 0.1μ, only the last 0.25μ of an electron path is capable of producing a break. Thus they deduced that 17 ionizations is the minimum number required to break a chromatid; this is the number of ionizations produced in the path length of 0.1μ between 0.15μ and 0.25μ from the end of the track. An electron of range less than 0.1μ is likely to be very inefficient. Such electrons have energy less than 1.53 kv., and it may therefore be said, roughly, that the effects of electrons of energy less than 1.53 kv. may be ignored.

Since the diameter of the chromosome threads to be considered in relation to the effects on human skin is almost bound to be less than that in *Tradescantia* (1), the probable consequences of this must be taken into consideration. On the basis of Read's considerations (8) of the lateral distribution of ions across the track of an ionizing particle, it may be concluded that the effects produced within chromatids of smaller radius than those of *Tradescantia* are likely to be greater for particles of the same ion density. Alternatively, one may say that a longer length, l, of electron path should be effective in producing breaks. The area A presented by the chromatid to the radiation would be smaller, however. In addition, the electron energy below which it will not be possible for electrons to traverse a chromatid thread will be less than the 1.53 kv. required for the threads of *Tradescantia*. The change in number of breaks per unit dose of a fixed radiation due to change in chromatid diameter will thus depend upon the relative effects of these factors.

In order to consider the *relative* effects produced by radiations of different quality or kind, the effects of such changes upon N and L must be considered. It is possible to do this at present only for *Tradescantia*, for which the requisite data are available, but having made these calculations, one may extrapolate very roughly to the conditions for thinner chromatids in order to see if the theory is at all likely to provide reasonable agreement with existing data. This approach has been used in what follows.

DEPENDENCE OF THE NUMBER OF CHROMATID BREAKS IN TRADESCANTIA UPON X-RAY WAVE LENGTH

In order to evaluate $N(L - 2r)$, the problem is essentially that of calculating for each wave length (which is assumed to be monochromatic) the number of electrons liberated per unit volume per unit of dose, having a range of at least 0.25μ in tissue. To a first approximation, the number of breaks will be proportional to this number of electrons.

The numbers of primary electrons liberated for an average tissue equivalent to muscle may be calculated by following the methods used by Lea (5) and the data given by Spiers (9) for energy absorption in muscle. The results of such calculations

TABLE I: NUMBERS OF PRIMARY ELECTRONS PROJECTED PER CUBIC MICRON PER 1,000 r OF X-RAYS IN AN AVERAGE TISSUE (MUSCLE)*

Wave Length λ in Å.	hν in ekv	Number of Recoil Electrons	Number of Photo-electrons	Total Number of Electrons	Mean Energy of Recoil Electrons in ekv
0.0050	2,480	0.0467	...	0.0467	...
0.010	1,240	0.103	...	0.103	...
0.015	826.6	0.177	0.0004	0.177	...
0.030	413.3	0.449	0.0017	0.451	...
0.060	206.7	1.260	0.0066	1.267	...
0.100	124.0	2.610	0.054	2.664	...
0.130	95.4	3.360	0.144	3.704	...
0.200	62.0	3.865	0.538	4.403	...
0.300	41.3	2.610	1.150	3.760	...
0.400	31.0	1.630	1.675	3.305	1.64
0.500	24.8	1.165	2.145	3.310	1.12
0.600	20.7	1.006	2.565	3.571	0.76
0.800	15.5	0.499	3.505	4.004	0.435
1.00	12.4	0.475	4.365	4.840	0.230

* No account is taken of pair production, which is negligible in tissue even for the shortest wave length considered in the table.

are given in Table I, where the calculated total numbers of ejected electrons per cubic micron of tissue per 1,000 roentgens are set out for a range of wave lengths up to 1Å. The partition of these electrons between recoil and photo-electrons is also shown.

For use in the expression $N(L - 2r)$, only those electrons having a tissue range of at least 0.25μ need be considered, that is only those with energy equal to or greater than about 2.75 kv. (5). In Table I (last column) are listed those mean energies of recoil electrons (5) which are less than 2.75 kv. These recoil electrons contribute little to the total and may be ignored in the calculations.[2] To these primary electrons must be added those δ rays, also of energy equal to or in excess of 2.75 kv., which are generated by the primary electrons. The numbers of these δ rays can be approximately evaluated from the data set out by Lea (5, Table 16).

Finally, account has to be taken of those electrons, both primary electrons and δ rays of energy between 1.53 and 2.75 kv. These are electrons which do not produce effects over the whole length $L(0.25\mu)$ of their path, but only over some shorter length l. For this purpose, we have evaluated approximately the total number (n) of electrons of energy between 1.53 and 2.75 kv. and have assumed that these all have an average range, $l = 0.175\mu$ (the average of $L = 0.25\mu$ and $2r = 0.1\mu$). The measure of the effect of these electrons is then taken to be $n(l - 2r)$, and the total breakage effect is represented by $N(L - 2r) + n(l - 2r)$. The values thus obtained for this expression over the range of wave lengths are listed in Table II.

We have compared the wave-length variation of these values with observed wave-length variation of the threshold erythema dose as follows. Trump (12) has given a graph showing the variation of the threshold erythema dose with voltages over a potential range of about 100 to 3,000 kv. We have assumed, as a sufficiently accurate approximation, that the voltages needed to generate average wave lengths equal to those listed in Table II are twice those equivalent to the monochromatic radiation. We have then fitted Trump's curve to the value in Table II for 0.10Å. (exciting voltage taken as 248 kv.) since in this region the skin erythema dosage data is probably most reliable. In Figure 1, Trump's curve is compared with the data of Table II thus obtained.

[2] Some of those recoil electrons possess energy greater than the mean value and so in fact may contribute. We therefore tend to underestimate the effects of the recoil electrons for these particular wave lengths. Similarly, when the mean recoil electron energy is slightly greater than 2.75 kv., we tend to over-estimate the effects because some, in fact, have energies less than the mean value. In this wave-length region, therefore, there will be a tendency for a somewhat artificial discontinuity to appear.

TABLE II: VALUES OF $N(L - 2r) + n(l - 2r)$ CALCULATED FOR VARIOUS WAVE LENGTHS AS A MEASURE OF CHROMATID BREAKAGE PRODUCED PER 1000 r OF X-RAYS PER CUBIC MICRON

Wave Length λ in Å.	$N(L - 2r) + n(l - 2r)$, *i.e.*, Number × Microns
0.015	0.210
0.030	0.284
0.060	0.361
0.100	0.519
0.200	0.755
0.300	0.726
0.400	0.616
0.500	0.388
0.600	0.438
0.800	0.572
1.00	0.687

chromosomes in the human skin being thinner than those of *Tradescantia* suggest that this change will have little significant effect upon the general shape of the theoretical curve.

An important feature seems to be that the two curves do not show completely dissimilar trends but have common features. We therefore felt justified in pursuing the subject further by considering what might, according to similar reasoning, be expected to happen with other types of radiation.

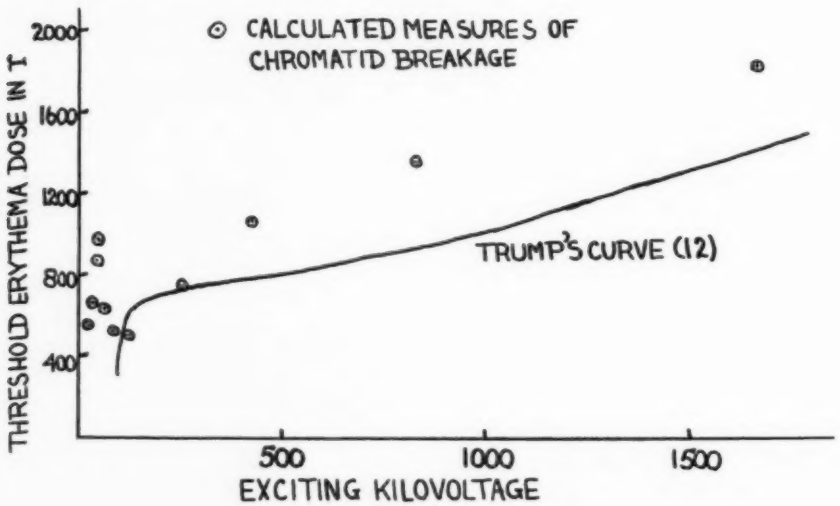

Figure 1.

It is seen that as the kilovoltage increases from about 100 the dose required to bring about the same effect in terms of chromatid breakage in *Tradescantia* increases qualitatively in much the same way as does the observed threshold erythema dose except that for one or two effective kilovoltages of the order of 40–50 kv. our calculations lead to exceptionally high values. It is in this voltage range that a discontinuity may occur in our calculated values as previously explained. It must also be borne in mind that the radiations used in practice generate photo-electrons not of one energy only, as the calculations assume, but of a wide range of energies. Approximate considerations of the probable effects due to the

CHROMATID BREAKAGE BY NEUTRONS

In the case of neutron irradiation, the ionizing particles responsible for the breakages are the recoil protons generated in the irradiated tissues. These protons have rather widely distributed energies, the exact distribution depending on the method of generation of the primary neutrons responsible for them. Lea (5, p. 21) has given a table of the energy and number distributions of the recoil protons produced in tissue by the $D + D$, $Li + D$, and $Be + D$ reactions, which is reproduced below as Table III. Using other data tabulated by Lea (5), it is possible to list the ranges in tissue of protons having energies equal to

TABLE III: DISTRIBUTION OF INITIAL PROTON ENERGIES IN TISSUE DUE TO VARIOUS NEUTRON BEAMS (5)

Reaction for Neutrons	Deuteron Energy in mev	Proton Energy in mev*									Total
		0–1	1–2	2–3	3–4	4–6	6–8	8–10	10–12	12–14	
D + D	0.3	31	31	31	7	..	..	..	...	...	100
		10	28	47	15	..	..	..	...	...	100
Li + D	0.9	51	19	12	4	6	4	2	1.5	0.5	100
		11	15	14	11	17	12	9	7	4	100
Be + D	8.0	12	12	12	12	24	19	9	...	...	100
		2	5	7	10	29	31	16	...	...	100

* In each case the upper lines give the percentages of the total *numbers* of protons, the lower lines the percentages of the total *energy* of protons.

TABLE IV: RANGE IN TISSUE AND ION DENSITIES CORRESPONDING TO THE PROTON ENERGY GROUPS LISTED IN TABLE III

	Proton Energy in mev								
	0–1	1–2	2–3	3–4	4–6	6–8	8–10	10–12	12–14
Tissue range in μ corresponding to mean group energy	10	49	107	188	355	632	1004	1430	1880
Primary ions/μ corresponding to the energy values	398.2 and greater	398.2 to 217.0	217.0 to 151.8	151.8 to 117.7	117.7 to 82.1	82.1 to 63.6	63.6 to 52.2	Less than 52.2	

the mean values of the various energy groups listed in Table III and also the ion density (ions/μ) range corresponding to protons of the energies of these groups. These data are given in Table IV.

An examination of the ion density values in Table IV leads one to suppose that protons of energy greater than about 2.5 mev should have a low probability of breaking *Tradescantia* chromatid threads since, to a first approximation, protons of these energies have ion densities less than 170 ions/μ, *i.e.*, less than the 17 ions per 0.1μ that are required for the breakage of a chromatid thread of diameter 0.1μ. We have assumed (cf. 4) that the breakage probability is zero until the energy of the proton has fallen to 2.5 mev or less, when it is taken to be unity. We thus assume that the measure of the amount of chromatid breakage due to recoil protons is $\Sigma n(l - 2r)$, where n is the number of protons in each energy group, l is now the length of range over which the proton energy is less than 2.5 mev, and $2r$ is, as before, the diameter of the chromatid thread. In their original considerations of this question Lea and Catcheside did not take the distribution of proton energies into account but considered all the protons to produce the same ion density. Later, however, Lea (5, p. 272) made passing reference to the fact that the more energetic protons may have a low probability of producing breakage.

Using further data tabulated by Lea, we have evaluated $\Sigma n(l - 2r)$ as follows: From Table III above and Lea's data (5, p. 8) it is possible to calculate the numbers of protons in the various energy groups ejected per cubic micron per 1,000 ν units[3] of neutrons for D + D neutrons, Li + D neutrons, and Be + D neutrons respectively. These numbers are listed in Table V. Of these groups, the effective ranges of those protons of energy equal to or less than the 2–3 mev group have, on the above assumption, been taken to have an effective range l equal to the actual range given in Table IV. Those protons in the energy

[3] The ν unit is an energy unit (5, p. 22) of any radiation dissipating the same energy in 1 gm. of tissue as 1 roentgen of γ rays dissipates in 1 gm. of water.

TABLE V: NUMBERS OF PROTONS EJECTED PER CUBIC MICRON OF TISSUE PER 1,000 ν (ENERGY UNITS) OF NEUTRONS IN THE DIFFERENT ENERGY GROUPS

Reaction for Neutrons	$\Sigma n(l - 2r)$, *i.e.*, Numbers × Microns	Numbers of Protons ($\times 10^{-3}$) of Energies in mev								
		0–1	1–2	2–3	3–4	4–6	6–8	8–10	10–12	12–14
D + D	2.364	13.65	12.40	12.40	2.82	...	...	...	...	...
Li + D	1.586	15.02	6.64	3.70	2.07	2.23	1.12	0.65	0.415	0.20
Be + D	1.298	2.73	2.22	1.85	1.88	3.80	2.89	0.436	...	...

TABLE VI: CALCULATED MEASURE OF CHROMATID BREAKAGE EFFECTS IN TRADESCENTIA DUE TO THE RECOIL PROTONS AND THE ASSOCIATED δ RAYS LIBERATED PER CUBIC MICRON BY 1,000 ν OF NEUTRONS OF VARIOUS ENERGIES

Reaction for Neutrons	$n(l - 2r)$, *i.e.*, Numbers × Microns as a Measure of Effect Due to Protons	Contribution to Effect Due to δ Rays, *i.e.*, Numbers × Microns	Total Measure of Effect
D + D	2.364	0.167	2.531
Li + D	1.586	0.208	1.794
Be + D	1.298	0.206	1.504

group above the 2–3 mev group have all been taken to have an effective range equal to 107μ, the value for the 2–3 mev group. The $\Sigma n(l - 2r)$ values obtained on this basis for the different neutron beams are given in Table V, column 2.

In addition it is necessary to take account of the effects which should be produced by δ rays liberated along the proton tracks. Still further data of Lea's (5, Table 17B) enable one to calculate the numbers of δ rays of energy greater than 2.75 kv. and the numbers with energy between 1.53 and 2.75 kv. The measure of the effect of these δ rays may then be evaluated in exactly the same way as were the effects due to electrons liberated by x-rays.

In Table VI we have listed the total measures of the effects due to such δ rays along with the contributions (from Table V) due to the primary protons and the sum total of the two. It is seen that the contribution due to δ rays may be a small but not negligible proportion of the total. But, whereas the contribution due to primary protons varies considerably with the neutron source, that due to δ rays is much the same in each case. The data of Table VI indicate that, as a general rule, one would expect beams of neutrons to decrease in efficiency of production of this type of biological effect as a greater proportion of high-energy protons are produced, that is, roughly, as the energy of the neutrons increases. So far as work has progressed, Stone (10, 11) has observed just such a decrease in efficiency of production of the skin erythema reaction by neutron beams with increase in neutron energy. Thus once again we do not find complete contradiction between what might be expected in terms of the above type of theory for chromosome breakage in *Tradescantia* and for the human skin reaction. While the theory that the human skin reaction has its basic cause in the production of chromosome abnormalities is not proved by these findings, it is at least not entirely ruled out.

EFFECTS PRODUCED BY FAST PROTONS

It has been suggested by Parker (6) that the radiotherapeutic use of fast protons may become a reality when machines yielding protons of energy up to 125 mev or more are completed. The ideas we have presented here suggest that the ionization dose of such protons which will be required to produce the skin erythema reaction might possibly be much greater than that so far observed for beams of neutrons. Roughly this should be so because such a

large proportion of the proton track in tissue may prove ineffective in producing chromosome damage, because of the low ion density it should produce. A very rough extrapolation of the data already used indicates that a value of about 0.114 would be the total measure of the effect to be compared with the values in Table VI; of this, approximately one half should be due to δ rays.

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SUMARIO

Especulaciones Acerca de la Dependencia de la Reacción Provocada en la Piel Humana por la Radiación Yonizante, de la Clase de Radiación

Ciertas especulaciones aquí expuestas básanse en la suposición de que la reacción de la piel humana a la radiación yonizante reconoce como causa fundamental la producción de anomalías de los cromosomas, debidas a desintegración ya de los cromosomas mismos o de los cromátides.

A base de las observaciones de Lee y Catcheside en Tradescantia, se ha construído una curva teórica que representa la desintegración cromosómica a consecuencia de las radiaciones de distintos kilovoltajes en la piel humana. El plan de esa curva es semejante al de la publicada por Trump (Radiology **50**: 651, 1948), que muestra las variaciones en la dosis eritemática límite debidas a rayos X de diversa calidad.

Parece igualmente posible aplicar la teoría de la desintegración de los cromátides como índice del efecto de la radiación a la neutronoterapia y al posible empleo radioterapéutico de los protones.

Experimental Procedures for the Simultaneous Exposure of Large Numbers of Animals to Total Body X-Radiation[1]

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IN EXPERIMENTAL radiology it is often desirable to irradiate simultaneously large numbers of animals in an incident field of identical characteristics. In attempting such experiments the following difficulties are encountered:

With conventional clinical x-ray units or small industrial units, the fields of uniform radiation are small; only a limited number of small animals can be exposed at one time, and for the exposure of large animals, unless distance and intensity are altered, numerous ports are needed. With multiple ports there is much overlapping of the fields of irradiation and the ultimate dosage may be difficult to estimate. In addition, the slightest inconsistency in tube output or any discrepancy in duplicating geometrical relationships makes it difficult to repeat the lethality of a given exposure with the smaller x-ray units.

Biological variations are evidenced by the wide range of individual responses observed following a given exposure. Lorenz (1) has shown that there is less variability in the lethality of total body irradiation when highly inbred strains of laboratory animals are used. Inbred rabbits, guinea-pigs, and dogs are not readily available, however, and the availability of inbred mice and rats is limited because of the great demand for them in other experimental fields. On the other hand, when a heterogeneous strain of laboratory animal is used, the basic genetic pattern of the strain is constantly changing and it becomes desirable to employ large, paired experimental and control groups of simultaneously irradiated animals in order to obtain statistically reliable data.

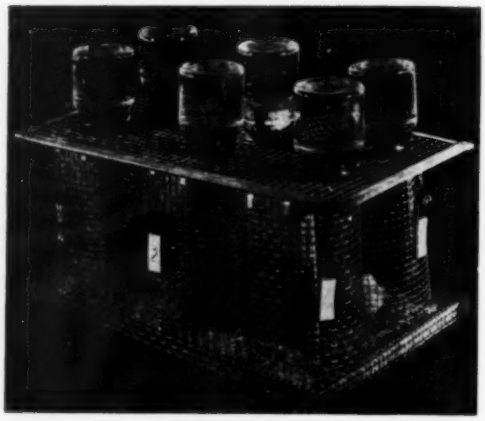

Fig. 1. A unit of six individual cages for total-body irradiation of mice.

Animals caged in groups may exhibit varying degrees of pugnacity and cannibalism. While these factors are not always in evidence, they are unknown potentialities which may directly or indirectly affect the outcome of any experiment. By housing and irradiating animals in individual cages we have attempted to eliminate these factors and at the same time provide a greater degree of uniformity in experimental irradiation procedures.

In previous work at this Institute the radial beam of a G.E. 1,000-kv.p., 3-ma., industrial x-ray unit was used to irradiate swine and goats (2). The present report is concerned with the use of this same x-ray

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[1] From the Naval Medical Research Institute, Bethesda, 14, Md. Project NM 006 012.05.03. The opinions and assertions contained herein are those of the authors and are not to be construed as official or reflecting the views of the Navy Department.

The procedures described are presented in less detail by Chapman, Sipe, Eltzholtz, Cronkite, Lawrence, and Chambers, under the title "A Method for the Simultaneous Exposure of Large Numbers of Animals to Single Dose High Intensity Total Body X-Ray Radiation," Project NM 007 039, Report No. 14, Naval Medical Research Institute, Aug. 12, 1948.

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unit and, in addition, a 2,000-kv.p. unit of similar design, for simultaneously irradiating large numbers of different laboratory animals under rigidly controlled conditions.

PROCEDURE

In order to eliminate as many of the above mentioned difficulties as possible, the following procedures have been adopted for handling and irradiating mice, rats, guinea-pigs, rabbits, and dogs. The methods of handling mice will be described in detail. Other species are handled similarly inasmuch as they are housed and irradiated in individual cages.

When mice are obtained from the Institute's stock colony at weaning, they are divided so that litter mates are equally distributed between male and female experimental and control groups. All mice are then placed in 9 × 9 × 15-inch stock cages (15 mice per cage) and given water and Purina Laboratory Chow *ad libitum*. Within a week or ten days they are placed in individual cages, numbered consecutively, and observed for an additional three or four weeks.

The individual cages for mice are illustrated in Figure 1. These cages are constructed of 1/4-inch-mesh hardware cloth. For each mouse there is a cylinder 6-1/4 inches in height and 4 inches in diameter. Six of these cylinders are attached to a wire base, which in turn fits over a 9 × 15-inch metal tray. A 9 × 15-inch section of hardware cloth serves as a top for the six individual cages. Water bottles hold the cage top in place and prevent the mice from escaping.

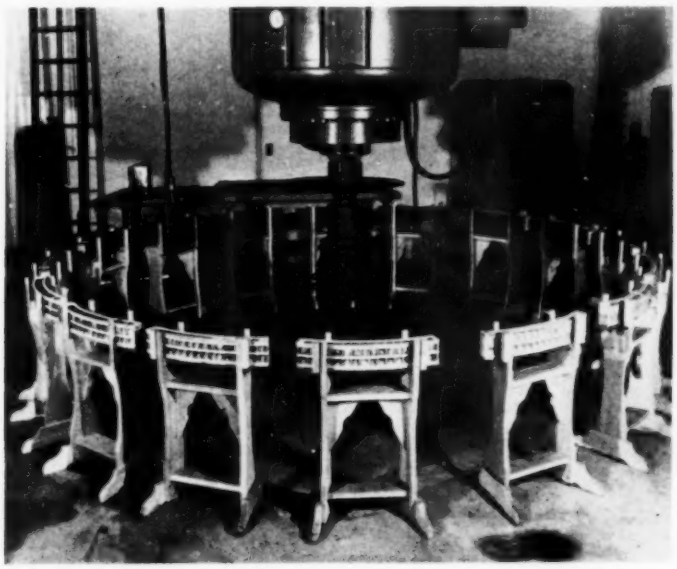


Fig. 2. Disposition of mouse irradiation cages for simultaneously exposing 512 mice to the radial beam of the 2-mev x-ray unit.

When the mice are fifty to sixty days old, they are used for experimental work.

Either a 1-mev or a 2-mev G.E. industrial x-ray unit is used for total body irradiation. The direct or radial beam from either unit may be employed. The radial beam has proved more satisfactory for most of our requirements in that it provides, at any fixed radius, a cylindrical field of uniform intensity sufficiently large for irradiating several of the larger animals or several cages of small animals at the same time. Animals are irradiated by placing them in specially constructed cages which are disposed in a circle about the x-

ray source (Fig. 2). The entire lethal dose range can be determined simultaneously by initially placing all animals of an experiment in the field of radiation and then successively removing animals or cages of animals, as they receive their prescribed dose of x-rays.

The radial beam is used for studying the effects of x-ray on different animals exposed either at the same rate or at different rates. Since the field of radiation from the direct beam is relatively small, it is used only for high-intensity, high-rate studies with the smaller animals.

All irradiation cages have individual compartments so that the identity of each animal is retained throughout its experimental life. After exposure to irradiation, animals are returned to their respective observation cages, where they are weighed daily and studied for the ensuing twenty-eight days.

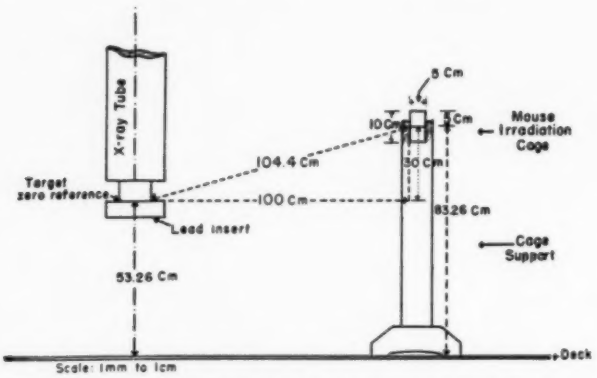


Fig. 3. Geometric relationship of the 1-mev x-ray tube to the mouse irradiation cages.

MATERIALS AND METHODS

A. X-ray Units

1. The 1-mev G.E. industrial unit at the Naval Gun Factory, Washington, D. C. Radiation factors: 1,000 kv.p., 3 ma., no added filter, h.v.l. 2.2 mm. Pb. Mean intensity of the radial beam: 31.2 r/min. in air at 1 meter.

2. The 2-mev G.E. industrial x-ray unit at the Naval Ordnance Laboratory, White Oaks, Md. (3). Radiation factors: 2,000 kv.p., 1.5 ma., no added filter. Intensity of the radial beam: 15.0 (±0.15) r/min. in air at 2 meters, h.v.l. 4.3 mm. Pb. Mean intensity of the direct beam in center of field at 2 meters: 36.3 r/min. in air, h.v.l. 7.45 mm. Pb. At F.S.D. 25.4 (±1.4) cm., the intensity of the direct beam is 2,500 (±250) r/min. (added filtration: 0.6 mm. Cu, 0.6 mm. Al, and 3.0 mm. lucite).

In the initial report on the use of the 1,000-kv.p., 3-ma. G.E. industrial x-ray tube (2), the maximum intensity of the field of radiation at 1 meter distance from the center of the tube was found to be 30 cm. above the horizontal zero reference plane (Fig. 3). The maximum intensity of the field of radiation at 2 meters distance from the center of the 2,000-kv.p., 1.5-ma. G.E. industrial x-ray tube is 41 cm. above the zero reference plane. Irradiation cages and cage supports were constructed so that the center of each cage nearest the source of radiation is at the elevation corresponding to the field of maximum uniform intensity.

B. Irradiation Cages

1. *For Studying the Mortality of Animals Simultaneously Exposed to the Same Rate of Irradiation:* The first series of irradiation cages was designed for exposing mice, rats, guinea-pigs, rabbits, or dogs in the radial beam of a 1-mev or 2-mev x-ray

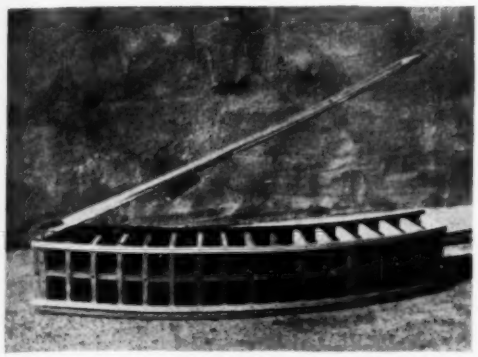


Fig. 4. Irradiation cages for mice: 2 tiers, 32 compartments.

unit. Each of these cages conforms to a segment of a circle the radius of which is 1 meter. The curvature of the cages was limited by the size of the largest animal to be studied, *i.e.*, the dog. By having this series of cages constructed with the same radius of curvature, different species of laboratory animals may be subjected to the same rate of irradiation at the incident surface, thereby providing a better basis for comparing experimental data from the different species.

The description and inside dimensions of the cages are as follows:

(*a*) *For Mice* (Fig. 4): The framework of the cages for mice is of 1/4 inch wood. Each cage has two tiers and a total of 32 compartments. The inside dimensions of each compartment are: length, 6.5 cm.; width, 3.0 cm.; height, 4.5 cm. The outside dimensions of the cages are: length, 67.0 cm.; width, 7.5 cm.; height, 10 cm. The concave side of each cage is of 1/8-inch masonite. The convex side of the cage is covered with screen wire. The top and bottom are detachable wooden frames with screen wire on the inside surfaces.

Loading is effected by sliding the cage lid along as each compartment is filled. The cage is then inverted for loading the opposite side. The lids are finally secured with cord.

These cages, although built for use at 1 meter distance, can be used at 2 meters because the difference in the curvature of the 2 meter circle does not appreciably alter the irradiation received at the end and center of the cages (1.5 per cent variation in irradiation received at end and center of cages when used at 2 meters).

During irradiation the cages are supported by wooden stands. Eight of these cages can be placed around the x-ray tube in a circle of 1 meter radius or 16 cages may be used in a circle of 2 meters radius.

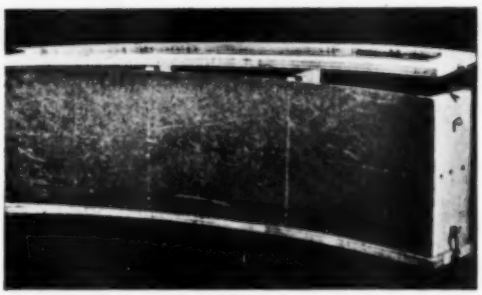


Fig. 5. Irradiation cage for rats or guinea-pigs: 2 tiers, 6 compartments.

(*b*) *For Rats or Guinea-Pigs* (Fig. 5): The cages for rats and guinea-pigs are made in two tiers. The sides are made of 1/8-inch masonite. The ends and partitions are made of 1/2-inch plywood for structural bracing. The top and bottom are each hinged at one end and constitute an open frame for the screen wire, which is placed on the inside surface in order best to support the weight of the animals in the bottom tier. Each tier measures $9 \times 9 \times 65$ cm. and is divided into three compartments, each 21 cm. long.

Ninety-six rats or 48 guinea-pigs can be irradiated simultaneously at 1 meter; twice these numbers can be exposed at 2 meters.

(*c*) *For Rabbits* (Fig. 6): The rabbit cages measure 83 cm. in length, 11 cm. in width, and 14 cm. in height. Each cage is divided in half by a single partition. The sides are made of 1/8-inch masonite, the ends and partitions being of 1/2-inch plywood. The top of the cage is hinged at one end and screened on the inside.

Fourteen rabbits can be irradiated at the same time at 1 meter distance; 28 can be

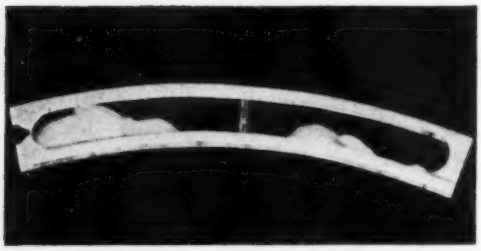


Fig. 6. Irradiation cage for rabbits: 1 tier, 2 compartments.

exposed at 2 meters. Due to the inverse-square effect, however, it is preferable to expose an animal of this size at the 2 meter distance. Furthermore, in order to equalize the tissue dose throughout the whole body, an animal of this size or larger should be turned during the exposure so that half the total dose of x-rays is delivered to each side.

(*d*) *For Dogs* (Fig.7): The dog cages are constructed of 3/16-inch plywood. They are 100 cm. in length, 26 cm. in width, and 30 cm. in height. The top and bottom of each cage are of 3/4-inch plywood; the sides and ends are of 3/16-inch plywood.

Six dogs can be irradiated simultaneously at 1 meter or 12 may be exposed at 2 meters. Dogs are irradiated bilaterally, *i.e.*, half the total dose is administered to each side of the animal.

2. *For Studying the Mortality of Mice Simultaneously Exposed to Different Rates of Irradiation.* (*a*) Four cages were constructed, comprising a complete circle, of 50 cm. radius. Each cage has two tiers and each tier has 15 compartments. The inside dimensions of each compartment are: length, 5 cm.; width, 3 cm.; height, 4 cm. The over-all length of each cage is 80 cm.

(*b*) Four additional cages, comprising a circle of 33 cm. radius hold 8 mice each, in individual compartments. The inside dimensions of each compartment are: length, 6 cm.; width, 3 cm.; height, 5 cm. The over-all length of the cage is 55 cm. Figure 8 illustrates the disposition of these cages about the tube.

The support for these two circles of cages consists of two 4 × 4-foot pieces of 1/4-inch masonite with diametrically opposing slots that fit around the x-ray tube housing. The masonite squares are positioned and clamped together for rigidity. Concentric circles are inscribed on the uppermost sheet to facilitate the placement of cages.

When all mouse cages are used at the same time, it is possible to irradiate simultaneously a maximum of 512 mice at 2 meters, 256 mice at 1 meter, 60 mice at 50 cm., and 32 mice at 33 cm. Using this equipment with the 2-mev unit, those mice

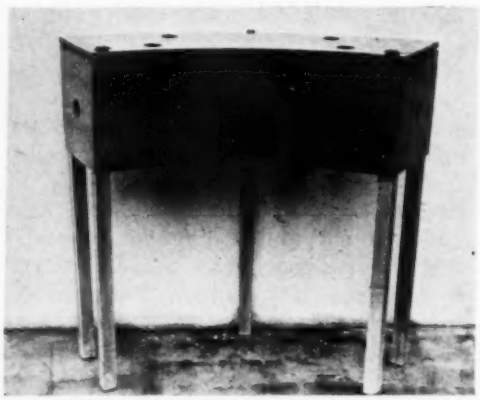


Fig. 7. Dog irradiation cage: single compartment.

at 2 meters receive 15 r/min.; at 1 meter the output is 57.2 r/min.; at 50 cm. 209 r/min.; and at 33 cm. 500 r/min.

3. *For Studying Mortality of Mice Exposed to High Rates of Irradiation:* Lucite cages were designed for use in the direct beam of the 2-mev unit.

Figure 9 illustrates the type cage used at 40 cm. The tube output at this distance is 1,000 r/min. This cage is of 1/8-inch lucite. It has six compartments, the inside dimensions of which are 3.58 × 3.58 × 5.54 cm.; the outside dimensions: 4.22 × 12.01 × 12.01 cm. For loading, there is a sliding door at either end.

Figure 10 illustrates the type of cage which is placed inside the x-ray tube housing. A copper and aluminum filter, 6.75 × 6.75 × 10 cm., open at the lower end, is first inserted inside the tube housing. This

filter is held in place by the lead shutters which, if completely closed, would occlude the direct beam. The lucite cage is positioned inside this filter. This cage has two compartments, the inside dimensions of which are 3.08 × 3.08 × 6.48 cm. and the outside dimensions: 7.11 × 7.11 × 7.11 cm. At 25.4 (±1.4) cm. the x-ray intensity is 2,500 (±250) r/min.

DISCUSSION

Uniformity in physical radiation factors, methods of irradiation, and biological material is of the utmost importance in radiological experimentation. The experimental procedures described in this report were established to eliminate as many extraneous factors as possible, thereby facilitating the evaluation of those factors which influence the course of radiation illness.

Lorenz (1) has shown that the effects of radiation can be consistently duplicated only in the most highly inbred animals. As previously mentioned, inbred animals are not always readily available for large-scale experimentation, and some strains have dominant characteristics which are undesirable in radiological studies. When suitable inbred animals are not available and it becomes necessary to use relatively large numbers of a heterogeneous strain in order to obtain reliable data, the use of the radial beam of the 1- and 2-mev x-ray units is highly desirable, because the field of uniform radiation intensity is large enough for exposure of several large animals or several cages of small animals simultaneously. One is thus able to use sufficient numbers of any species or strain of laboratory animal to obtain statistically reliable data with a minimum number of exposures.

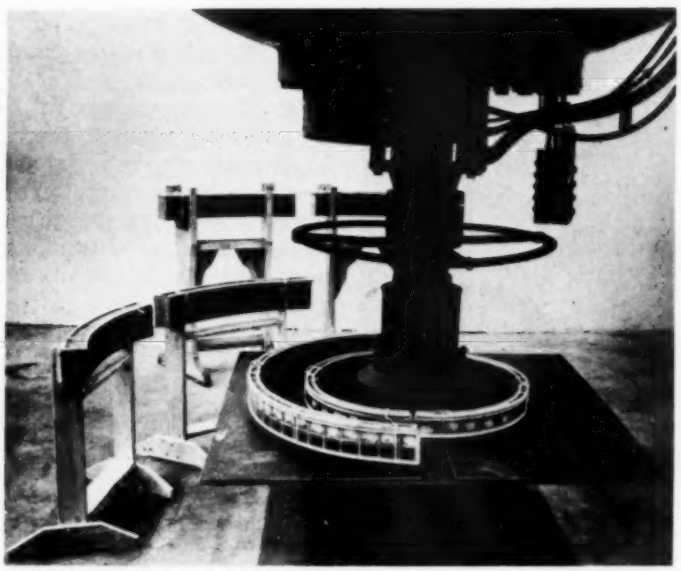
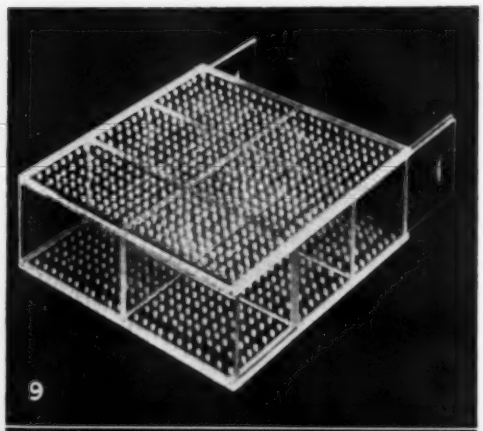


Fig. 8. Simultaneous exposure of mice to the following doses of x-radiation: 500 r/min. at 33 cm.; 209 r/min. at 50 cm.; 57.2 r/min. at 1 meter; 15 r/min. at 2 meters.

The method of placing animals in a circle around a source of radium has been used by Lorenz in chronic exposure studies (4).

With either the 1- or 2-mev unit the calibration of the net beam intensities includes all back-scatter from the building walls, and, with the energies employed, the effect of scatter and absorption by the lightly constructed cages proves to be neg-



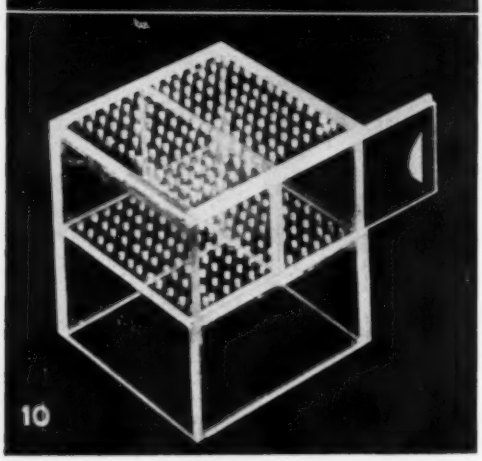


Fig. 9. Lucite cage for exposing mice to the direct beam of the 1- and 2-mev x-ray units: 6 compartments.

Fig. 10. Lucite cage for exposing mice inside the x-ray tube housing of the 2-mev unit: 2 compartments.

ligible, so that data are treated as of free-air dosages. For example, a masonite cage wall 0.5 cm. thick is numerically significant when compared with a mouse 2.5 cm. in thickness, but the depth dose curve is sufficiently flat in this region that the effects of scatter and absorption may be neglected entirely (3). On the other hand, with a dog 20 cm. in thickness, the actual ratio of wall cage thickness to animal mass is so small that we may again assume the influence of the cage wall to be essentially zero. It is further obvious that with increasing distance the effect of animal thickness on per cent exit dose must decrease rapidly (purely by inverse-square ratio, neglecting any absorption). Relative figures for a 2.5 cm. mouse, an 11 cm. rabbit, and a 20 cm. dog are as presented in Table I.

It is apparent that, by increasing the distance with high-energy radiation, the incident-exit dose ratio is decreased, thereby providing a more uniform unit tissue dosage and a better basis for comparing radiation effects in animal species of varying thicknesses. With the mouse, relatively uniform irradiation is obtained at 200 cm. With larger animals it becomes necessary to use the bilateral exposure technic in order to get uniform irradiation of the whole body.

By placing animals at 1 or 2 meters from the x-ray source, the chance of error in duplicating distance and position is greatly reduced, so that exposures may be repeated with a greater degree of accuracy. It is possible to perform multiple experiments with small animals and use a single non-irradiated control group. These methods are especially appropriate for scanning the effect of a therapeutic agent over the entire lethal dose range, because this can be accomplished with one exposure.

When the dose-mortality response is being used as a quantitative measure of the relative effects of varying energies of radiation, dose rates, or the influence of pharmacologic agents, special attention must be paid to the randomization and selection of animals in respect to age, sex, size, weight, litter mates, and any other parameter that might possibly influence the radiosensitivity or the radiation geometry.

The adoption of individual cages for irradiation and observation purposes has several advantages. The effects of fighting and cannibalism are eliminated. This is especially important if animals have been injected or if they have been subjected to operative procedures. With individual cages, one can be assured that all animals are subjected to more uniform conditions during irradiation, and, during pre- and post-irradiation observation periods, individual variations and responses can be

TABLE I: INFLUENCE OF INVERSE-SQUARE EFFECT ON INCIDENT-EXIT DOSE RATIO

	2.5-cm. Mouse $\frac{\text{exit dose}}{\text{incident dose}}$	11 cm. Rabbit $\frac{\text{exit dose}}{\text{incident dose}}$	20-cm. Dog $\frac{\text{exit dose}}{\text{incident dose}}$
a. At 50 cm.	$\frac{(50)^2}{(50 + 2.5)^2} = 90.7\%$	$\frac{(50)^2}{(50 + 11)^2} = 67.2\%$	$\frac{(50)^2}{(50 + 20)^2} = 51.0\%$
b. At 100 cm.	$\frac{(100)^2}{(100 + 2.5)^2} = 95.2\%$	$\frac{(100)^2}{(100 + 11)^2} = 81.2\%$	$\frac{(100)^2}{(100 + 20)^2} = 69.4\%$
c. At 200 cm.	$\frac{(200)^2}{(200 + 2.5)^2} = 97.5\%$	$\frac{(200)^2}{(200 + 11)^2} = 89.8\%$	$\frac{(200)^2}{(200 + 20)^2} = 82.6\%$

more easily observed. Individual compartments eliminate the danger of suffocation and insure uniformity of exposure in that animals do not shield one another. This is of little consequence with mice, because the exit dose for these animals is essentially 100 per cent. With the larger animals, however, this factor becomes important. With each animal numbered and occupying a separate cage, the position of each in relation to the tube is known. This is important if the anode becomes pitted or for any other reason produces an asymmetrical field. It is also advantageous to retain the identity of each animal for subsequent serial killings, hematological, biochemical, and pathological studies; and finally, when individual cages are used, food and water consumption can be ascertained without employing additional cages, simply by modifying the type of containers.

The irradiation of animals by free-in-air technic *versus* full back-scatter with 200-kv.p. x-rays has been carefully considered by Ellinger (5). In the present paper back-scatter has been purposely minimized and for practical purposes it can be considered that all animals are irradiated free in air.

SUMMARY

Methods and materials are described for housing and irradiating animals in individual cages. Large numbers of mice, rats, guinea-pigs, rabbits, or dogs can be simultaneously exposed to the same rate of x-radiation by housing them in specially constructed irradiation cages which are positioned in the field of maximum uniform intensity of the radial beam of 1- and 2-mev x-ray units. Methods are also described for studying the mortality of mice exposed simultaneously to different rates or to high rates of x-irradiation.

By simultaneously exposing large numbers of animals in individual cages it is possible to minimize many extraneous physical factors and obtain in a single experiment statistically reliable data on factors which may influence the mortality of radiation illness.

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(*Para el sumario en español, véase la página siguiente.*)

SUMARIO

Procedimientos Experimentales para la Exposición Simultánea de Grandes Números de Animales a la Radiación X Total del Cuerpo

Los métodos y materiales descritos están destinados al alojamiento e irradiación de los animales en jaulas separadas. Alojándolos en jaulas construídas ex-profeso para la irradiación y colocando éstas en el campo de máxima intensidad uniforme del haz radial de aparatos de rayos X de 1 y 2 mev, es posible exponer simultáneamente grandes cantidades de ratones, ratas, cobayos, conejos o perros al mismo valor de radiación X.

También se describen métodos para estudiar la mortalidad de los ratones expuestos simultáneamente a distintos valores o a valores altos de radiación X. Para el primer propósito utilízanse dos círculos de jaulas apoyadas en cimientos de masonita, con ranuras diametralmente opuestas que se amoldan alrededor de la casilla que alberga el tubo de rayos X. Para el segundo propósito, se usa una jaula de lucita, colocada dentro de la casilla que alberga el tubo.

Mediante la simultánea exposición de grandes números de animales en jaulas separadas, resulta posible reducir al mínimo muchos factores extraños y obtener en un solo experimento datos bien fundados acerca de factores que pueden afectar la mortalidad de la enfermedad irradiatoria.

Influence of Infection on the Hematological Effects and Mortality Following Mid-Lethal Roentgen Irradiation[1]

L. R. BENNETT, M. D.,[2] P. E. REKERS, M. D.,[3] and J. W. HOWLAND, M. D.

IN MANY STUDIES of the mortality following exposure to lethal amounts of ionizing radiation, bacterial infection has been regarded as playing a major role. Very little data can be found, however, on the incidence of bacterial infection, or its nature, and the resulting effect on radiation morbidity or mortality. Warren and Whipple (1) studied the blood and tissue of dogs sacrificed two, three, and four days following massive dosages of x-radiation to the abdomen. The dosage used was lethal in three to six days and caused extensive destruction of the intestinal epithelium. In these animals the incidence of positive bacterial cultures was higher than in controls, but no evidence of an overwhelming sepsis could be demonstrated. These findings were extended by Chrom (2) and by Lawrence and Tennant (3), who obtained a high incidence of positive cultures for enteric organisms from the blood and tissues of mice during the second week after lethal dosages of x-rays or neutrons. Miller and associates (4) demonstrated a bacteremia in mice during the second week after lethal whole body irradiation. The organisms isolated were predominantly the gram-negative bacilli normally present in the lower intestinal tract of the mouse.

In the study to be reported here blood cultures of 54 dogs receiving whole body irradiation with mid-lethal doses of 350 to 450 r were examined. Positive cultures of many types of organisms were obtained during the period of survival. Positive cultures of gram-negative organisms appeared to be closely related to the terminal state. Some correlation was demonstrated between the leukocyte counts and the mortality. In dying animals a consistent relationship between infection and anemia was noted.

TABLE I: ANALYSIS OF BLOOD CULTURES AFTER LETHAL ROENTGEN IRRADIATION
(430 cultures; 17 per cent positive)

Days	Aerobes				Anaerobes
	Gram Positive		Gram Negative		
	Bacilli	Cocci	Bacilli	Cocci	
1–7	1	7	3	1	4
8–14	1	9	5	0	5
15–21	1	6	7	0	5
22–28	3	7	3	1	4
+28					1
TOTAL	6	29	18	2	19
Terminal		5	7		

METHODS

Dogs used in this experiment were healthy mongrels, six months to two years of age. All were being used in various studies of vitamin P compounds given three times daily before and after irradiation (5). Whole body dosage of 350 r, the mid-lethal level for this laboratory (6), was used for most experiments. A few animals received 450 r. The irradiation factors were 250 kv., 15 ma., filtration-aluminum parabolic (9 inches in diameter and 0.56 inches at center) + 0.5 mm. copper, half-value layer 2.15 mm. copper, target-skin distance 40 inches, intensity 7.0 r per minute.

Complete hematological studies were performed prior to irradiation and three times weekly following irradiation. Bacteriological studies were carried out at the same time, the cultures being taken from the jugular vein following surgical preparation by shaving, soap and water scrubbing, and application of zephiran. Four-milliliter samples of blood were ob-

[1] From the Department of Radiation Biology, University of Rochester, School of Medicine and Dentistry, Rochester, N. Y. Accepted for publication in November 1950.
This paper is based on work performed under contract with the United States Atomic Energy Commission at the University of Rochester Atomic Energy Project, Rochester, N. Y.
[2] Now at University of California Atomic Energy Project, West Los Angeles, Calif.
[3] Now at Cedars of Lebanon Hospital, Los Angeles, Calif.

TABLE II: TYPE AND INCIDENCE OF BACTERIA ISOLATED FROM BLOOD CULTURES AFTER LETHAL ROENTGEN IRRADIATION OF DOGS

	Number of Positive Cultures	Number of Positive Terminal Cultures
Gram-positive cocci		
Staph.	16	3
Strep.	13	5
Unclassified	1	0
	30	8
Gram-positive rods		
Cl. welchii	18	0
Cl. fallax	2	0
B. subtilis	2	1
Unclassified	6	0
	28	1
Gram-negative		
E. coli	7	7
A. aerogenes	1	0
Salmonella	2	1
Hæmophilus	3	3
Unclassified	5	1
	18	12
Diphtheroids	8	2
TOTALS	84*	23†

* Includes 10 duplicate positive cultures taken on the same day.

† Includes 6 duplicate positive terminal cultures.

tained, half of which were placed in Douglas broth and half in deep meat broth. Aerobic cultures were kept five days and anaerobic cultures seven days. All organisms noted were identified by standard bacteriologic technics. Pour-plate estimations of the total bacteriologic count (number of organisms per milliliter of blood) were not performed routinely, and are not included in this report.

RESULTS

The results of blood cultures obtained from the 54 animals are summarized in Table I, by weekly periods. Terminal cultures obtained within twenty-four hours of death are shown separately. Control blood cultures were taken on 53 of the 54 animals before irradiation. The single positive culture in this group showed an alpha hemolytic streptococcus. A total of 430 cultures were made in the thirty days after irradiation. Of these, 84 were positive, or 17.0 per cent. The type and incidence of the isolated organisms are shown in Table II. Of 34 cultures taken after the thirtieth day, none was positive. Examination of terminal blood cultures reveals a higher incidence of gram-negative organisms, particularly *E. coli*. *Cl. welchi*, while more frequent in appearance, does not appear to be related to either morbidity or mortality.

MORTALITY

In the entire series of 54 dogs, 32 died, an over-all mortality of 59 per cent. Of the 32 animals dying, 22 were studied within the twenty-four-hour period prior to death, and 17 of these, or 77 per cent, were found to show positive blood cultures. Five animals in which positive cultures were not obtained died ten to eighteen days after irradiation, a period in which severe metabolic disturbances from radiation are present (7). All animals dying after the eighteenth day showed positive cultures. It might be postulated that some evidence exists that, in the two weeks immediately following irradiation, death may occur solely as a result of the primary toxic effects of the radiation, and that, after this period, infection alone or combined with hemorrhage plays a much more dominant role in radiation mortality.

TABLE III: RELATION OF THE LEUKOCYTE COUNT TO BLOOD CULTURE

WBC	Negative	Positive	Positive in Last 24 Hours of Life	Negative in Last 24 Hours of Life
Over 5,000	25	7		
3,000 to 5,000	28	7		
2,000 to 3,000	33	4		
1,000 to 2,000	81	11		
500 to 1,000	55	7	1	2
0 to 500	58	8	19	7

RELATIONSHIP OF POSITIVE CULTURES TO LEUKOCYTE COUNT

Table III shows the frequency of positive cultures compared directly with the leukocyte count at the time at which the culture was taken. As high a percentage of positive cultures was noted in irradiated

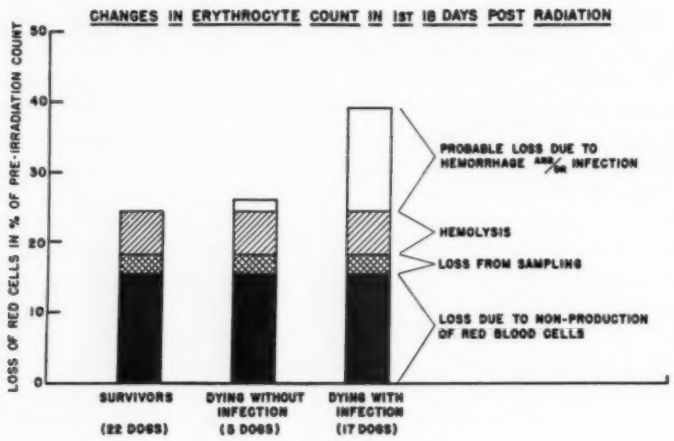
animals with leukocyte counts in excess of 5,000 as in those with counts below 500. It is worthy of comment, however, that although positive blood cultures were frequent in animals with leukocyte counts in excess of 3,000 cells per cu. mm., none apparently died as the direct result of such infection. Repeated negative cultures were always obtained from these animals prior to death. It is significant, however, that where counts exceeded 3,000, gram-positive rods and cocci predominated, while in severe leukopenia with counts of less than 500, *E. coli* and other gram-negative rods were predominant. In the latter animals *Hæmophilus*, *Salmonella*, and beta and alpha streptococci were also found terminally.

It is common knowledge that a direct correlation exists between depression of the leukocyte count and mortality. This series lends further support to this idea, inasmuch as all dying animals showed leukocyte counts below 500 during the twenty-four hours prior to death. Careful examination of our data does not suggest that bacterial invasion or sepsis may be related to the severe leukopenia. A severe depression of the white cell count often exists two to five days before positive terminal blood cultures are obtained. Since low counts are also noted in animals dying without positive cultures, it is possible that these animals might have shown infection had cultures been obtained with greater frequency.

RELATIONSHIP OF INFECTION TO ERYTHROCYTE COUNT

The high percentage of positive cultures of hemolytic organisms suggests the possibility that some of the reduction in circulating red cell mass might be due to added hemolysis, partially of infectious origin. In a study of such changes the following observations appear pertinent. Red blood cell production ceases following irradiation, as evidenced by a depression in reticulocyte count in almost all animals; only 1 animal of our series failed to show this finding. Surviving animals showed a marked fall in red cell mass between the third and fourth week after irradiation. When one correlates this absence of erythropoiesis with the observations of Prosser and associates (7) that following irradiation the mean blood volume shows no change, and also with the fact that the red cell life in the dog is approximately 120 days, one can calculate a decrease in the circulating red cell mass of approximately 1 per cent per day for the first eighteen days. The direct hemolytic effect is also shown by the rise in urinary urobilinogen in animals receiving sublethal doses. This amounts to between 1 and 2 per cent (6). Another factor which complicates analysis is the possibility of hemorrhage, either massive or diffuse. These variables make the question of hemolysis by bacterial infection difficult to evaluate.

When animals with demonstrable evidence of bacterial infection are compared with those without infection, a definite difference in the red cell count is shown. This is best observed within the first eighteen days post-irradiation and is too great to be accounted for by the loss of red cells expected from normal red cell breakdown in the absence of erythrocyte production. In animals dying without demonstrable infection, an average fall to 74 per cent of pre-irradiation values is found. This is almost identical with the observed decrease in surviving animals, namely, 76 per cent of the pre-irradiation count. In animals dying with positive cultures a mean value of 61 per cent was noted, 13 to 15 per cent less than that for non-infected and surviving animals. The loss of red cells in the surviving and non-infected animals may be accounted for as follows: due to blocked production of new cells and death of old cells in the first eighteen days, 16 per cent; due to hemolysis, as measured by urobilinogen excretion, 7 per cent; loss from blood sampling, 3 per cent, giving a total calculated fall to 74 per cent of the pre-irradiation value. This is shown in Graph I. Of the infected group of 5 animals with profound anemia and fall in red blood count to between 30 and 40 per



Graph I.

cent of pre-irradiation values, all except one had a bacteremia, with hemolytic organisms. It is impossible to account for this marked reduction in circulating red cell mass without the addition of other possible factors. From the evidence presented, infection with hemolytic organisms could account in part for such red cell destruction. Hemorrhage related to the effects of exotoxins on the vascular mechanism should also be considered.

SUMMARY

Careful analysis of blood cultures taken on 54 dogs following whole body roentgen irradiation has demonstrated the relative frequency of all types of organisms. Infection appears to be definitely related to mortality in those animals surviving the first two weeks of irradiation. This relationship is less apparent in animals dying after a shorter interval. No direct correlation between the definite leukopenia of dying animals and infection could be made. The presence of gram-negative organisms within the circulating blood appears to be definitely related to subsequent death of these animals.

As a result of these observations, preliminary experimentation has been carried out to determine the effect on morbidity and mortality of dogs and rats, of the administration of various anti-bacterial agents. Aureomycin, streptomycin, sulfa drugs, penicillin, and terramycin have been studied extensively. Results will be reported elsewhere.

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SUMARIO

El Influjo de la Infección sobre los Efectos Hematológicos y la Mortalidad Consecutivamente a la Radiación X Meso-Letal

El cuidadoso análisis de los hemocultivos tomados a 54 perros después de la radiación X de todo el cuerpo ha revelado la relativa frecuencia de microbios de todo género en dichos cultivos. La infección parece estar netamente enlazada con la mortalidad en los animales que sobreviven las dos primeras semanas de irradiación. Esa relación es menos manifiesta en los animales que mueren antes de dicho período. No pudo establecerse ninguna correlación directa entre la leucopenia bien definida de los animales moribundos y la infección. La presencia de microbios gram-negativos en la circulación sanguínea parece estar netamente enlazada con la muerte subsiguiente de dichos animales.

A consecuencia de esas observaciones, se han llevado a cabo experimentos preliminares para determinar el efecto de varios agentes antibacterianos sobre la morbicidad y mortalidad de perros y ratas, habiéndose estudiado extensamente la aureomicina, la estreptomicina, las drogas sulfa, la penicilina y la terramicina. Los resultados serán dados a conocer más tarde.

Impulse Counter for Checking X-Ray Timers[1]

B. R. STEPHENSON, Ph.D., AND E. G. ESCHNER, M.D.
Buffalo, N. Y.

TIMERS used for short x-ray exposures are usually checked for accuracy with a spinning top. This method, while it is reliable, requires considerable time and film, and the results cannot be known until the film is processed. Adjustment of the timer, if it is required, involves still further loss of time, during which the machine must stand idle. To overcome these disadvantages, the impulse counter to be described here has been devised. With this counter the technician or service man can obtain an immediate check on the accuracy of the timer without loss of time, while the machine is in actual use.

The construction of the counter is simple. One Message Register (Western Electric, Type 14 E) is connected in series with a half-wave selenium rectifier (Fig. 1). A second Register is connected to another rectifier in the same way. These two units are connected in parallel so that each bears a polarity opposite to the other. One Register will thus be activated during one half cycle and the other Register during the opposite half cycle. The total of both counts will give the total number of impulses for a given time interval.

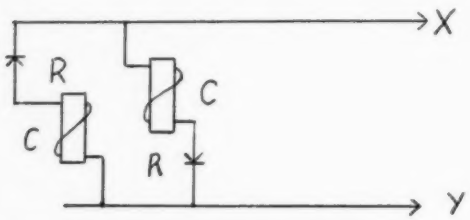


Fig. 1. Construction of impulse counter. R. Rectifier. C. Counter. X and Y. Connecting wires.

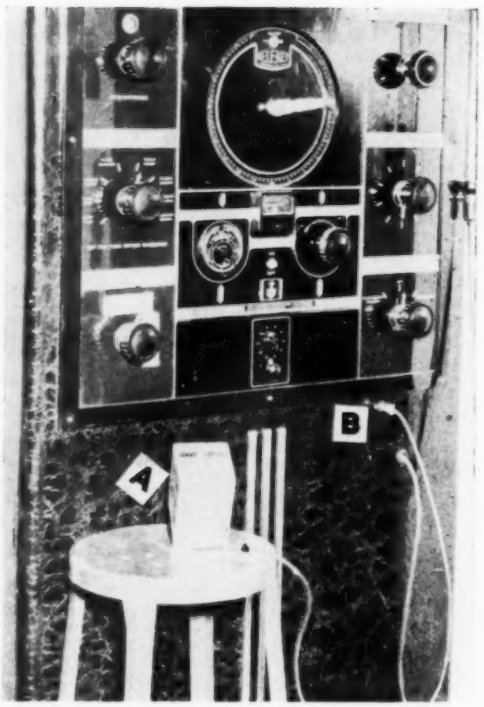


Fig. 2. A. The impulse timer. B. Connecting plug receptacle.

The counter (A, Fig. 2) is connected over the terminals of the primary coil of the high-tension transformer by placing two wires (X and Y, Fig. 1) over the primary binding posts on the wiring panel. These two wires are brought out to the front control panel to terminate in a plug receptacle (B, Fig. 2). The counter can then be plugged in at any time to make a quick check. The advantage of connecting over the primary coil is that any defect in the timer or magnetic switch is by-passed and only the actual number of impulses reaching the x-ray tube are counted. The total counts should be identical with the number of dots made with a spinning top. In the two counters constructed, a minimum of 120

[1] From the Department of Physics and Radiology, Edward J. Meyer Memorial Hospital, Buffalo, N. Y. Accepted for publication in October 1950.

volts A.C. is necessary to give reliable results.

The accuracy of the impulse counter is easily checked by comparing it with an impulse timer. If no impulse timer is available, the spinning top can be used for two or three spot checks.

A distinct advantage of this impulse counter is that, for experimental work, each exposure can be individually checked, including phototimers. With a phantom the thickness of the average patient, approximately 20 cm., one can adjust the phototimer circuit to give the desired density on a film in an experimentally determined time, less than the limiting time of half a second. To recheck a machine, or to calibrate a different machine, all that is necessary is to place the phantom in the same position as before and adjust the machine so it will cut off at the same time interval as before. This can be done quickly and does not involve a patient or use any film.

Edward J. Meyer Memorial Hospital
Buffalo 15, N. Y.

SUMARIO

Cuenta-Impulsos para Comprobar los Cronograduadores de Rayos X

Este cuenta-impulsos está destinado a comprobar la exactitud de los graduadores de breves exposiciones a los rayos X sin pérdida de tiempo ni interrupción de servicio. Cada uno de dos registradores de telegramas (Western Electric, Tipo 14 A) va unido en serie a un rectificador de selenio de media onda. Esos dos aparatos son unidos entonces en paralela, de modo que cada uno tenga una polaridad opuesta a la del otro. Un registrador se activa durante un semi-ciclo y en otro durante el semi-ciclo contrario. El total de ambas numeraciones da el número de impulsos para un plazo de tiempo dado. El cuenta-impulsos se conecta sobre el terminal de la bobina primaria del transformador de alta tensión colocando dos alambres sobre los tornillos de contacto primarios del panel de instalación de alambres. Estos se llevan al panel regulador del frente donde van a parar a un receptáculo de conmutación (véase la Fig. 2). El cuenta-impulsos puede después ser conectado en cualquier momento para verificar comprobaciones.

EDITORIAL

Radiology in Japan

A visit to Japan by an American radiologist is an experience at once salutary and enlightening. The economic and professional situation of the Japanese radiologist is so difficult, his working conditions so onerous, his equipment so inferior, as compared with ours, that the visitor is imbued with a deep gratitude for the opportunities afforded to us here in the United States.

The history of radiology in Japan dates back to early 1896; Roentgen's discovery was introduced into that country by a Japanese physicist who had been working in Roentgen's laboratory. The progress of radiology in Japan, as was the case in most fields of medicine, followed closely the German pattern until some time before World War II. Harassed by the demands of the military, long before the War, and ravaged by the War itself, the hospitals in Japan suffered greatly. Medical men in general were greatly restricted by a lack of facilities, proper equipment, and opportunities for educational advancement. The radiologist, because of the expensive character of his equipment, suffered probably more than all the rest. The technological development in this field practically ceased, so that, generally speaking, x-ray equipment in Japan at the present time is far behind ours. In some institutions it is completely antiquated; in others it is more modern but still grossly inadequate. Only now, for example, are rotating anode tubes being manufactured and coming into use. The Japanese use a condenser discharge apparatus to a far greater degree than do we for diagnosis and, to a lesser degree, for therapy. Their intensifying screens are much faster than ours but exhibit a serious lack of detail. Their films are somewhat slower; nevertheless, they, too, do not produce good detail.

The Japanese radiologist is intellectually well qualified and is thoroughly familiar with the radiological literature. Some of the Japanese radiologists have contributed most substantially to the advancement of the specialty; it should be noted that Koga, in Tokyo, practised photofluorography even before d'Abreu. Furthermore, Higuchi and several others have been using photofluorography for the examination of the stomach for a number of years. The radiologists in Japan have used body-section roentgenography probably to a greater degree than have we and some of their most modern equipment in this field, recently manufactured in their own plants, is of excellent character. Takahashi has done some splendid work on the development of various kinds of body-section radiography, including rotary types of section, with a very ingenious device for this purpose. These are only a few examples of the splendid contributions that have been made by Japanese radiologists; there are, of course, many others. In addition, many important research projects are under way.

The radiologist, in company with his fellow practitioners in Japan, is intensely interested in research and in graduate training. The departments in the various universities have large numbers of graduate students, most of whom spend five years of residency before being qualified as radiologists. Radiation therapy and roentgen diagnosis are still fairly well united in Japan although there, too, some tendency toward separation is evident.

The status of radiology in Japan differs widely from that in the United States. In Kyushu, the radiologist has an independent

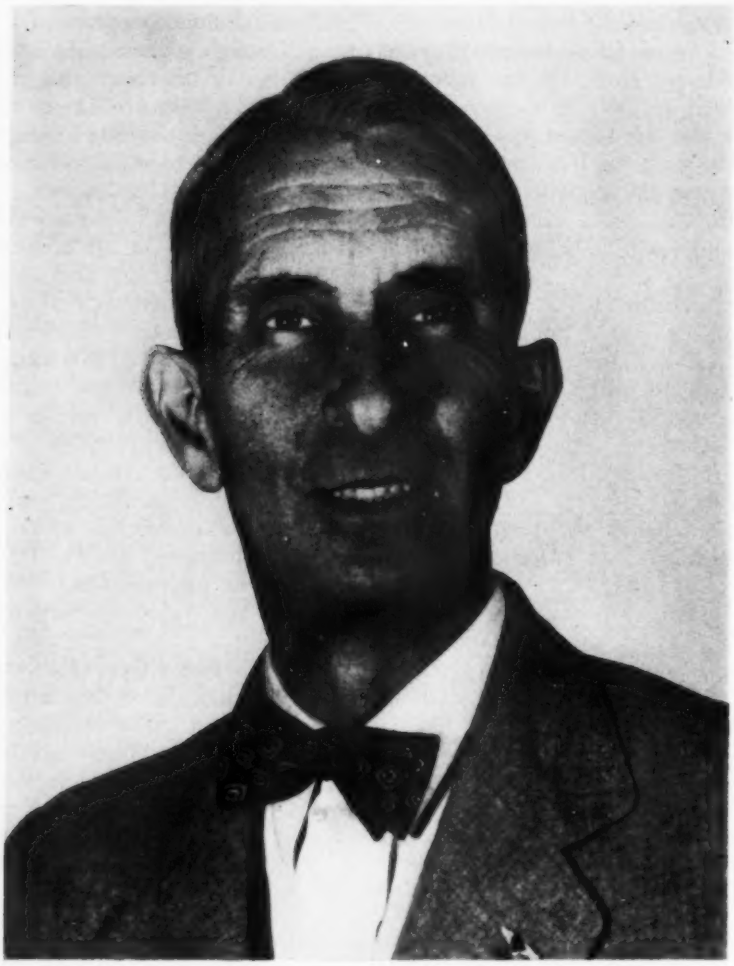
department, with his own patients and beds in the hospital, in much the same fashion as surgery or any of the other services. In most of the Islands, however, the radiologist is less fortunate and is given a relatively lesser status in the faculties and in medical groups; in very few universities has he an independent department. There is a great tendency to divide radiology among the various medical specialties with the usual result that the growth of radiology itself has been somewhat impeded.

In Japan, all the departments of the Medical Schools and hospitals are relatively isolated and independent of each other, so that radiology is far from the consultation service usually found in this country. Although enormously improved in the past few years, the economic situation in Japan is still very sad; any specialty which depends so much upon expensive equipment and materials as does radiology must inevitably suffer. But there is in evidence a new spirit among the radiologists. They are attempting to make a more important place for themselves in the medical schools, national health councils, and in the medical societies. An active radiological society exists, several good journals devoted exclusively to radiology are published, and a new feeling of co-operation within the profession is evident.

All of Japan is now oriented toward the United States. In medicine, however, the trend is slow, largely because of the profound influence exercised by the Germans for eighty years. Many of the textbooks are in German and much of the medical nomenclature is taught in German. Despite this, Japanese radiologists are sincerely anxious to make close contact with their American colleagues. They are hampered by a lack of knowledge of English; almost all of them obtained their graduate training on the European continent. They are desperately in need of medical journals and books in the English language. It is to be hoped that this need may soon be fulfilled and that a real interchange of students, scholars, and practitioners may be possible in the future. The Clinic of the Atomic Bomb Casualty Commission in Hiroshima serves as an excellent visible example of roentgen diagnosis as practised in the United States. As such it, too, contributes to the education of the Japanese radiologist in our methods.

The unifying effects of science are of the first importance in an otherwise sadly divided world. The cohesion of Japanese and American radiology may well serve to contribute in some part to the cultivation of friendly relations in one part of the Far East.

LEO G. RIGLER, M.D.
University of Minnesota



ROBERT BURBIDGE TAFT, M.D.

1899–1951

The many friends of Dr. Robert B. Taft were grieved to learn of his death on April 16, 1951.

Dr. Taft was born in Charleston, S. C., Sept. 20, 1899. His father, Dr. Augustus R. Taft, was a pioneer radiologist and during his earlier years of practice was forced to struggle with the more primitive types of equipment, such as induction coils, static machines, and gas tubes. Having unusual talent along electrical lines, Robert Taft spent a good part of his boyhood time in keeping his father's equipment in repair, thus establishing his interest in radiology and a yen to further his father's excellent work.

Robert Taft attended Porter Military Academy and in 1923 was graduated from the College of Charleston and the Medical College of the State of South Carolina with the degrees of B.S. and M.D. His internship and residency in radiology were served at Bellevue Hospital. After further postgraduate studies at the University of Michigan and the University of Vienna, he became assistant to his father until the latter's death in 1927. Following his father's affiliations, Dr. Robert Taft became a member of the Radiological Society of North America and of the American Roentgen Ray Society in 1926.

Besides conducting the practice of radiology in his private office, Dr. Taft was radiologist of Baker Sanatorium, Professor of Radiology and Director of the Department of Radioisotope Therapy at the Medical College of the State of South Carolina.

Having retained his boyhood interest in the physical phase of radiology, Dr. Taft spent much of his time making a close study of the observations of others as well as developing many notable additions to our apparatus. His wealth of ingenuity was coupled with unusual ability as an artisan. In his well equipped laboratory and workshop he would construct and perfect the objects of his design. One who does such experimental work realizes that there are many disappointments and much time lost in projects which fail to materialize as planned.

In 1926 he built an iontoquantimeter after the design of Bachem, with an improved charging device utilizing a Ford spark coil. The accuracy of this instrument was amazingly close to that of the most modern r-meter. One of Dr. Taft's interests for many years was the recovery of lost radium. The first instrument used by him was the gold leaf electroscope charged by the Ford spark coil, which was later replaced by the more sensitive Geiger counter. He received the Jefferson Medal of the South Carolina Academy of Science in 1929 for his paper on the "Radium Hound," and his book "Radium Lost and Found," published in 1938 and revised in 1946, has had a wide popularity among radiologists. He rendered valuable service to radiology by finding lost radium in many parts of the country.

To those of us who regularly attend the annual meetings it will seem strange not to see on display one of "Dr. Taft's gadgets." In recognition of the contributions made by these he was awarded by the American Roentgen Ray Society the silver medal in 1936 and Certificates of Merit in 1937 and 1942. The Radiological Society of North America gave honorable mention to his exhibit on the "Radium Hound" at its annual meeting in 1939. He also received honorable mention at a joint meeting of the two societies in Chicago in 1944, for an exhibit proving that films were fogged by radioactive contamination of cardboard fillers.

Dr. Taft became a Diplomate of the American Board of Radiology at its first examination in 1935. He had served as editor of the "Department of Technique" of the *American Journal of Roentgenology* for the past several years and as an instructor in Radiation Measurements in the Refresher Courses of that Society. He served as Counselor for South Carolina for several years and was elected second vice-president of the Radiological Society of North America in 1943. In 1949 he was appointed a medical consultant for the Institute of Nuclear Physics at Oak Ridge, Tennessee, and made frequent flights there in that capacity. He was made head of the radiological division of the Charleston Civil Defense organization in November 1950.

In addition to his accomplishments in the fields of radiology, Dr. Taft crowded an amazing amount of diversified activity into his relatively short span of life. He was the first individual to obtain a private pilot's license at the Charleston Municipal airport and was a member of the Board of Governors of that airport from 1935 to 1949. His skill as a pilot and thorough understanding of photography combined to make him an accomplished aerial photographer. Routinely he would use a camera of his own fabrication while making solo flights. His interest in aviation and radiology prompted an investigation which proved that irradiation from airplane instrument dials was harmless to pilots. This was published in a 1941 issue of *Newsweek*.

Having always shown an active interest in music, he completed a course in Theory which led him to make a device resembling a circular slide rule whence a guitar player could visualize fingering positions for all chords in any key. Later he learned to play the accordion, which afforded much entertainment for his friends. Other diversions included boating and water skiing.

Dr. Taft held membership in Kappa Alpha, St. Cecilia Society, New England Society, Rotary Club, and Carolina Yacht Club. He was very active in Masonry and in December 1950 was installed as Master of Union Kilwinning Lodge No. 4.

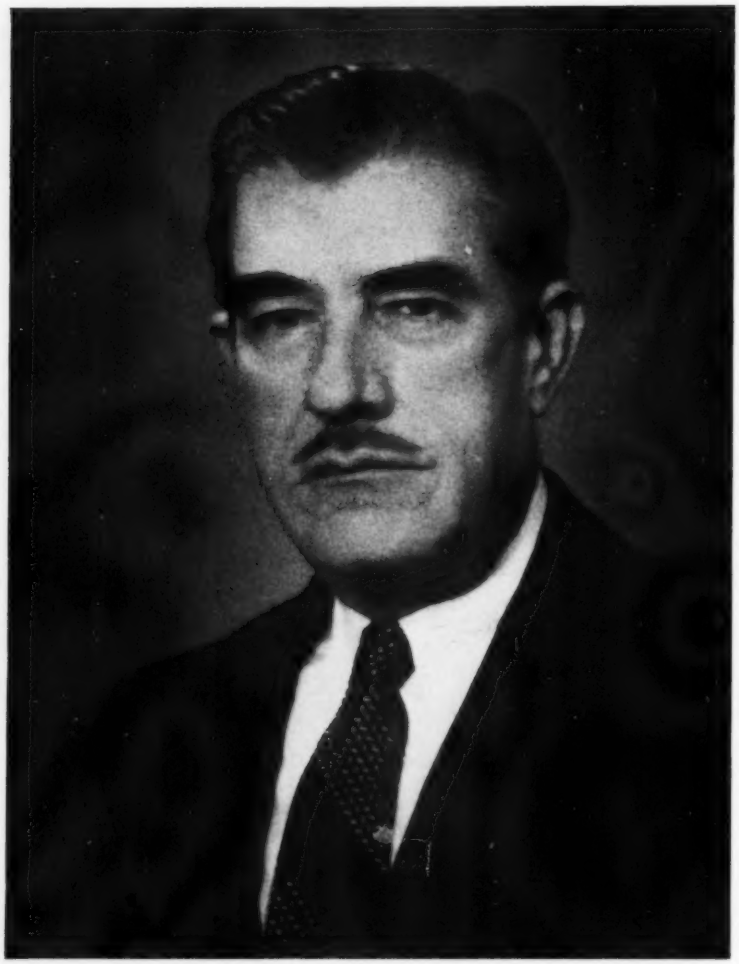
Survivors include his widow, the former Mary Joyce Steadman, and a daughter Miss Joyce Shannon Taft, both of Charleston; three sisters, Mrs. Taft Walker and Mrs. J. H. Lucas, Jr., both of Charleston, and Mrs. Ladson Mills, of Washington, D. C.

Dr. Taft will be greatly missed by a host of friends in and out of his profession. A brilliant career, with much promise of further accomplishment, was ended by the passing of this gentleman, scholar, and teacher. His spirit and achievements should inspire us all.

The following resolution adopted by the Georgia Radiological Society bespeaks the regard in which Dr. Taft was held by his fellow radiologists:

"WHEREAS, Dr. Robert Burbidge Taft went to his final reward on Monday, April 16, 1951 . . . We had experienced the happy privilege of having Dr. Taft as a guest speaker at one of our previous meetings, and the members of the Georgia Radiological Society knew, admired, and loved him. His vast store of radiological knowledge was surpassed only by his great personal attraction. He was always ready to help other radiologists, particularly in problems in radiation physics and therapy. The radiologists of Georgia feel a personal loss in the death of Bob Taft. As expressed by his friend, Robert Drane, 'Bob Taft died, as he lived, without ostentation.'"

PERCY D. HAY, JR., M.D.



PEDRO L. FARIÑAS, M.D.
1892–1951

Pedro Leandro Fariñas, illustrious figure of Cuban medicine and one of the most prominent radiologists of Latin America, died in his home, of coronary thrombosis, on April 26, 1951.

Doctor Fariñas was born in Santa Clara, Cuba, on Oct. 10, 1892. The son of humble parents, he found himself, at the age of ten, the citizen of a new country, the vigorous Republic of Cuba. He attended the High School of Santa Clara and was graduated doctor of medicine from the University of Havana in 1917. His interest in radiology started in his undergraduate years, when he worked as a technician in the Clínica de Dependientes of Havana. Upon his graduation, he became director of the Department of Radiology of that Hospital and joined the growing legion of enthusiasts who were writing chapters in the development of the young science of diagnostic radiology. He made yearly trips to the United States, where he met and worked with many of the American pioneers of radiology. Assiduously he worked towards the improvement of his own knowledge of radiology and the advancement of the specialty; his first publications on radiological examination of the stomach and on tuberculosis of bone appeared in 1916, and thereafter numerous publications on pneumoperitoneum, cholecystography, ventriculography, urography, etc., followed the opening of these new fields of radiology.

In 1935, Dr. Fariñas started a number of studies on serial bronchography in the diagnosis of suppurative pulmonary processes, bronchial tumors,

etc., which were published in German and English, as well as in the Spanish language. In 1941 he received the certificate of merit of the American Roentgen Ray Society for his exhibit on "A New Technique for the Arteriographic Examination of the Abdominal Aorta and Its Branches." In 1947 he presented a paper on "Bronchography by Atomization" before the Thirty-third Annual Meeting of the Radiological Society of North America. These original contributions of Fariñas and his associates and collaborators established his reputation in this country.

Through the growing pains and changing political tides of his young country, Fariñas worked persistently and unassumingly in the highest offices of the Federación Médica, the Colegio Médico, and the Retiro Médico for the social and economic betterment of generations of Cuban physicians, whose gratitude he earned.

Don Pedro, as he was known among his friends, worked consistently through radiology for the improvement of Pan-American medical relations and towards his ideal of Pan-American confraternity. He leaves numerous pupils throughout Latin America, including one of his own daughters, Dr. Laura Fariñas de Gómez, and his younger brother, Dr. Luis Fariñas, both of Havana. He was president of the Second Inter-American Congress of Radiology, and was one of the founders of the Colegio Interamericano de Radiología.

Fariñas was *académico de número* of the Academia de Ciencias of Havana; he was a member of the Radiological Society of North America and a corresponding member of the American Roentgen Ray Society. He was an Honorary Member of the Radiological Societies of Argentina, Colombia, Mexico, Venezuela and Peru, and a founding member of the Radiological Society of Cuba; he held membership also in numerous non-radiological societies in the United States and Latin America. He was declared "distinguished son" of his beloved home town, held the title of *comendador* of the order of Carlos Finlay, and was an Honorary Fellow of the American College of Radiology.

Fariñas was a shy, apparently emotionless but ambitious and indefatigable man who had few friends and was not given to the pleasures of conviviality; few were privileged to see the radiant expression of his smiling face. To Americans who met him, he appeared as a peculiar Latin with unusual perseverance and tenacity. Through his own efforts, he raised himself to a position of considerable wealth, and, like countless others, he was to learn that if personal success is to get what one wants, happiness, the goal of living, consists in wanting what one gets.

As a child, Fariñas must have heard this candid Cuban ballad, in the spirit of which he was to make his own contribution:

Cuba no debe favores
a ninguna extraña tierra;
en Cuba todo se encierra,
Cuba es un jardín de flores!

J. A. DEL REGATO, M.D.

CHARLES G. SUTHERLAND, M.D.

1877–1951

Dr. Charles G. Sutherland, for twenty-four years a staff member of the Section on Roentgenology of the Mayo Clinic, died on May 4, 1951, at Rochester.

Dr. Sutherland was born on June 19, 1877, in Hamilton, Ontario, Canada. He attended Hamilton Collegiate Institute, the University of Toronto, and McGill University, and in 1907 received the degree of M.B. from the University of Toronto, which in later years also bestowed on him the degree of M.D. He was an intern at the City Hospital of Hamilton from 1908 to 1910, practised at Cobalt and Porcupine, Ontario, from 1910 to 1912 and at Moose Jaw, Saskatchewan, from 1912 to 1915. From 1915 to 1918 he served with the British Army in the first World War. His association with the Mayo Clinic began in 1918, and continued until his retirement nine years ago at the age of sixty-five years. In 1942 he married Florence Julia Williams, who survives.

Among Dr. Sutherland's varied experiences he regarded his military record during World War I with particular satisfaction. When Great Britain entered the war in 1914, he enlisted immediately by telegraph in the Canadian Medical Corps, but was not accepted for duty until 1915, when he was called to England. There he was assigned to the British Medical Corps and sent to Eastbourne, where he was made acting commanding officer of the 102nd Field Ambulance of the 34th Division. This organization he equipped and trained, then relinquished its command to a superior officer and accompanied it to France, where it participated with distinction in the battles of the Somme and of Arras. In 1917 he was sent to Salonika, where he was made second in command of the 42nd Stationary Hospital. Later he was made acting major and senior medical officer of an emergency base on the Gulf of Corinth. After a visit to Athens, he returned to America in 1918.

In October of that year he began his association with the Mayo Clinic. After serving for five years as first assistant in the Section on Roentgenology, he was made an associate consultant and later was appointed assistant professor of radiology in the Mayo Foundation, Graduate School, University of Minnesota. During the years that followed he

Charles G. Sutherland, M.D.

rendered devoted professional service to the Section and devised for it a system of records that has been remarkably satisfactory for thirty years.

Notable among the many organizations to which Dr. Sutherland belonged are the American Medical Association, the Radiological Society of North America, of which he was at one time librarian, the American Roentgen Ray Society, the American College of Radiology, which he served as historian, the Canadian Radiological Society, and Sigma Xi.

Dr. Sutherland's manifold capabilities inspired immediate confidence, and, as a rule, when he engaged in any new activity he was soon given a post of responsibility in its management. He was generous, and never forgot those who were kind to him. Faithful to his friends, his ideals and his trusts, he will be remembered with affection and respect by all who knew him. B. R. KIRKLIN, M.D.

BERNARD F. SCHREINER, M.D.

1886–1951

The death on May 8, 1951, of Dr. Bernard F. Schreiner of Buffalo, N. Y., closed a career that was both scientifically productive and humanely fruitful.

Bernard F. Schreiner was born in Buffalo, on Dec. 26, 1886. Following his graduation from Canisius College, he matriculated at the University of Buffalo Medical School, from which he received his

Bernard F. Schreiner, M.D.

degree on May 29, 1909. In January 1911, following his internship at the Buffalo General Hospital, he was appointed surgeon at the New York State Institute for the Study of Malignant Disease. This institution, which is now known as the Roswell Park Memorial Institute, is the oldest cancer research hospital in the world. From 1911 to 1914, Dr. Schreiner worked also in the Department of Pathology at the Buffalo General Hospital, and from 1913 to 1920 he was an assistant attending surgeon at the Buffalo General Hospital and instructor in surgery at the Medical School. From 1917 to 1922, he was an assistant surgeon at the Buffalo City Hospital and from 1926 to 1929 he was an attending surgeon at the Buffalo Sisters of Charity Hospital. Until his retirement in 1945, he was the Principal Cancer Physician at the Roswell Park Memorial Institute to which he devoted his full time during latter years. Even after his retirement he maintained his avid interest in oncology.

Dr. Schreiner in his early professional life was privileged to be associated with many talented pioneers in cancer research, including Doctors Roswell Park and Harvey Gaylord. As head of the dispensary and hospital, he was responsible for many advances in the clinical application of radium, radon, and x-rays. During these years, he authored or co-authored seventy-four scientific papers. He was a Fellow of the American College of Surgeons and an Honorary Diplomate of the American Board of Radiology in therapeutic radiology. He was a member of the American Medical Association, Buffalo Academy of Medicine, American Radium Society, Radiological Society of North America, and the American College of Radiology.

WALTER T. MURPHY, M.D.

MID-SUMMER CONFERENCE OF ROCKY MOUNTAIN RADIOLOGICAL SOCIETY

The Mid-Summer Conference of the Rocky Mountain Radiological Society will be held Aug. 9–11, at the Shirley-Savoy Hotel, Denver, Colo. The following is the Preliminary Program.

Thursday Morning, Aug. 9

Vision by X-Ray, Robert R. Newell, M.D.

Luncheon and Discussion with Guest Speakers

Thursday Afternoon

Cysts of the Mediastinum, Howard P. Doub, M.D.
Angiocardiography in Congenital Heart Disease, R. Parker Allen, M.D.
Growth of the Atomic Energy Program, Paul C. Aebersold, Ph.D.
Growth Changes of the Extremity Associated with Tuberculosis of the Hip, Frederick S. Webster, M.D.

Thursday Evening: Joint Meeting with Denver County Medical Society

What Isotopes Have to Offer in Medical Practice and Research, Robert R. Newell, M.D.
Lymphoma: A Ten-Year Follow-up, Hugh F. Hare, M.D.

Friday Morning, Aug. 10

Roentgen Procedures in the Management of Pregnancy, Angus K. Wilson, M.D.
Cerebral Angiography, Curtis H. Burge, M.D.
Reliability of Reading Chest Films, Robert R. Newell, M.D.
Lesions Affecting the Cranial Vault, Hugh F. Hare, M.D.
Tarsal Anomalies and Peroneal Spastic Flat Feet, Frederick S. Webster, M.D.

Luncheon and Discussion with Guest Speakers

Friday Afternoon

Conditions Affecting the Temporomandibular Joints, Howard P. Doub, M.D.
Symposium on Diseases of the Colon
Coproliths, H. M. Berg, M.D., and J. R. Williams, M.D.

Friday Evening: Banquet (Informal)

Saturday Morning, Aug. 11

Paper by John H. Freed, M.D.
Pulmonary Metastasis, Peter E. Russo, M.D.
Growth of the Atomic Energy Program, Paul C. Aebersold, Ph.D.
Calcifying Tendinitis of the Shoulder: A Critical Study of the Value of X-Ray Therapy, Henry P. Plenk, M.D.
Prepyloric Suspect Lesion, Fay K. Alexander M.D.

Luncheon and Discussion with Guest Speakers

Saturday Afternoon: Annual Picnic

ARIZONA RADIOLOGICAL SOCIETY

At a meeting of the Arizona Association of Pathologists and Radiologists in April 1950 it was decided to disband that organization in order that each of the specialties represented might establish its own society. The Arizona Radiological Society was immediately organized with a membership of fifteen, and officers were elected as follows: President, Dr. Maurice Richter, Phoenix; Vice-President, Dr. Herbert D. Welsh, Tucson; Secretary-Treasurer, Dr. R. Lee Foster, 507 Professional Bldg., Phoenix.

The Society will hold its annual meeting in conjunction with the annual meeting of the State Medical Society, and an interim meeting six months later.

RADIOLOGICAL SECTION BALTIMORE CITY MEDICAL SOCIETY

At a recent meeting of the Radiological Section of the Baltimore City Medical Society, the following officers were elected: President, J. Howard Franz, M.D.; Secretary-Treasurer, Richard B. Hanchett, M.D., 705 Medical Arts Bldg., Baltimore 1.

Meetings of the Society are held the third Tuesday of each month, September through May.

NEW ENGLAND ROENTGEN RAY SOCIETY

At the annual meeting of the New England Roentgen Ray Society held on May 18, 1951, the following officers were elected for the ensuing year: President, Dr. Joseph H. Marks, Boston; Vice-President, Dr. Lawrence A. Martineau, Providence, R. I.; Secretary, Dr. Laurence L. Robbins, Massachusetts General Hospital, Boston; Treasurer, Dr. Magnus I. Smedal, Boston.

The Holmes Annual Lecture was prepared by Dr. Byrl R. Kirklin of Rochester, Minn., and was presented by his son, Dr. John Kirklin. The program of the meeting was audible, over a three-way telephone hook-up, to both Dr. George W. Holmes and Dr. Kirklin, whose comments added much to the interest of the meeting.

PENNSYLVANIA RADIOLOGICAL SOCIETY

At the meeting of the Pennsylvania Radiological Society, May 18–20, the following officers were elected for the coming year: President, Dr. Maurice

F. Goldsmith, Pittsburgh; President-Elect, Dr. William V. Dzurek, Pottsville; First Vice-President, Dr. Robert P. Meader, Pittsburgh; Second Vice-President, Dr. John Boger, Reading; Editor, Dr. Carl B. Lechner, Erie; Secretary-Treasurer, Dr. James M. Converse, 416 Pine St., Williamsport, Penna. Dr. C. L. Hinkel, of the Geisinger Memorial Hospital, Danville, was elected Counselor to the American College of Radiology.

SOUTH CAROLINA X-RAY SOCIETY

At its meeting in May 1951, the South Carolina X-Ray Society elected the following officers for the coming year: Harold S. Pettit, M.D., Charleston, President; Malcolm Mosteller, M.D., Columbia, Vice-President; Henry E. Plenge, M.D., 855 N. Church St., Spartanburg, Secretary-Treasurer; George M. Wyatt, M.D., Orangeburg, Counselor to the American College of Radiology.

The Society holds two meetings yearly, one at the annual meeting of the State Medical Association in May, the other at the call of the president.

WISCONSIN RADIOLOGICAL SOCIETY

The second annual meeting of the Wisconsin Radiological Society was held on Saturday, May 19, 1951, at the Edgewater Hotel in Madison. The following officers were elected for the ensuing year: President, Dr. Ernst A. Pohle, Madison; President-Elect, Dr. John L. Armbruster, Milwaukee; Member of Board of Directors, Dr. P. W. Snowden, Monroe; and Secretary-Treasurer, Dr. Irving I. Cowan, 425 East Wisconsin Ave., Milwaukee.

ASOCIACIÓN ARGENTINA DE RADIOLOGIA

At a special meeting of the Argentine Association of Radiology, held during the Third Argentine Congress of Radiology in Córdoba, two awards were made. The Roentgen Gold Medal was awarded to Dr. Lidio G. Mosca, of Córdoba, for his outstanding efforts in the field of radiological research, and the Mentor Gold Medal to Dr. Quirno Codas Thompson, of Asunción, Paraguay, in recognition of twenty-five years of uninterrupted service as Professor of Radiology.

At the closing session of the Congress, it was decided to hold the Fourth Congress during the coming year, in Santa Fé, and Dr. Raul Meyer of that city was elected chairman.

DR. K. J. FRANKLIN

Dr. K. J. Franklin, Professor of Physiology of the University of London, has been appointed Visiting Professor of Physiology at the University of Illinois for the academic year beginning Sept. 1, 1951. Radiologists will be especially interested in this appointment because of Dr. Franklin's association with the late Dr. Alfred Barclay in much of his radiological research.

Letter to the Editor

The editor is in receipt of a letter from Dr. A. Glucksmann, of the Strangeways Research Laboratory, Cambridge, England, calling attention to the abstract of his paper, The Role of the Tumour Bed in the Treatment of Squamous-Cell Cancers by Irradiation (J. Obst. & Gynaec. Brit. Emp. **57:** 322–327, June 1950) in the April 1950 issue of RADIOLOGY (p. 626). He believes that an important point has been missed and that the abstract may be misleading. Dr. Glucksmann writes:

"I wrote (p. 326) 'The tumour bed undoubtedly plays a role in successful radiotherapy, but this influence is due to the proximal tumour bed which is alike at primary and secondary sites. The main feature, however, which distinguishes radiocurable from radioincurable epitheliomas is the capacity of the cancer cells to react to radiation with an increase in extent and degree of differentiation. Where this capacity is present, the reaction of the proximal tumour bed may help or hinder its realization; but this capacity is inherent in the tumour cells and cannot be induced by any stroma reaction.' On the same page experiments on mouse tumours are described which show 'that the distal tumour bed has no marked influence on the results of radiotherapy. The proximal tumour bed, however, was found to greatly influence the result of treatment.'

"Your abstractor writes: 'Contrary to the commonly accepted view, the author does not believe that the tumour bed plays a decisive role in the response of squamous-cell carcinomas to radiation. He feels that radiocurable epitheliomas are distinguished from others mainly in their ability to react to radiation with an increase in the extent and degree of differentiation, and that this capacity is inherent in the tumour cells, and cannot be induced by any stroma reaction.'

"The omission in the abstract of the distinction between the proximal and distal tumour bed and of the influence of the stroma on the inherent capacity for differentiation gives a misleading impression. As many people may rely on the abstract without referring to the original paper I would be most grateful if you could find space in your Journal to correct the misconception likely to be created by the published abstract as it now stands."

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

POST-GRADUATE LECTURES ON ORTHOPEDIC DIAGNOSIS AND INDICATIONS. By ARTHUR STEINDLER, M.D., F.A.C.S., Professor of Orthopedic Surgery, State University of Iowa, Iowa City, Iowa.

Volume II. Section A. Paralytic Disabilities. Section B. Static Disabilities. A volume of 198 pages, with 140 figures. Published by Charles C Thomas, Springfield, Ill., 1951. Price $6.00.

TUMORS OF THE EYE. By ALGERNON B. REESE, M.D., D.Sc. (Hon.), F.A.C.S., Attending Ophthalmologist and Pathologist, Institute of Ophthalmology, Presbyterian Hospital, New York; Ophthalmologist to Memorial Center for Cancer and Allied Diseases, New York; Clinical Professor of Ophthalmology, College of Physicians and Surgeons, Columbia University. A volume of 574 pages, with 511 illustrations, 122 in full color. Published by Paul B. Hoeber, Inc., New York, 1951. Price $20.00.

ROENTGEN MANIFESTATIONS OF PANCREATIC DISEASE. By MAXWELL HERBERT POPPEL, M.D., F.A.C.R., Associate Professor of Clinical Radiology, New York University-Bellevue Medical Center; Associate Roentgenologist, New York University Hospital; Associate Radiologist, Mount Sinai Hospital; Roentgenologist, Welfare Island Dispensary, New York City; Consultant in Radiology, United States Naval Hospital, St. Albans, Long Island, N. Y.; Attending Consultant in Radiology, United States Veterans Administration Hospital, Bronx, N. Y.; Commander (Medical Corps), United States Naval Reserve. A volume of 390 pages, with 166 illustrations. Published by Charles C Thomas, Springfield, Ill., 1951. Price $10.50.

CHEST X-RAY DIAGNOSIS. By MAX RITVO, M.D., Assistant Professor of Radiology, Harvard Medical School; Instructor in Radiology, Tufts Medical School; Roentgenologist-in-Chief and Director, Department of Radiology, Boston City Hospital; Associate Radiologist, Beth Israel Hospital, Boston, Mass.; Radiologist, Jewish Memorial Hospital, Jewish Tuberculosis Sanatorium of New England, Revere Memorial Hospital, and Hudson Hospital. A volume of 558 pages, with 615 illustrations on 418 engravings and a colored plate. Published by Lea & Febiger, Philadelphia, 1951. Price $15.00.

LEHRBUCH DER RÖNTGENDIAGNOSTIK. By H. R. SCHINZ, W. E. BAENSCH, E. FRIEDL, E. UEHLINGER, with contributions by E. BRANDENBERGER, A. BRUNNER, U. COCCHI, N. P. G. EDLING, J. EGGERT, F. K. FISCHER, M. HOLZMANN, H. KRAYENBÜHL, Å. LINDBOM, E. LINDGREN, G. A. PREISS, S. WELIN, AND A. ZUPPINGER. Vol. I. The Skeletal System. Part IV. A volume of 514 pages, with 674 illustrations. Published by Georg Thieme, Stuttgart, 5th completely revised edition, 1951. Sole distributors for U. S. A. and Canada: Grune & Stratton, Inc., 381 Fourth Ave., New York 16, N. Y.

NOUVEAU TRAITÉ D'ÉLECTRO-RADIOTHÉRAPIE. L. DELHERM. Edited by DR. R. COLIEZ, PROFESSOR A. DESGREZ, PROFESSOR P. LAMARQUE, AND PROFESSOR A. STROHL. Vol. I. Généralités physiques et biologiques. Vol. II. Système nerveux. Glandes endocrines. Os. Articulations. Sang et ganglions. Dermatologie. Vol. III. Voies aériennes. Tube digestif. Voies urinaires. Organes génitaux. A total of 2,776 pages, with 995 figures, 11 plates, 58 tables. Published by Masson & Cie, Paris. Price 16,000 fr.

Book Reviews

PHYSICS IN MEDICAL RADIOLOGY. By SIDNEY RUSS, C.B.E., D.Sc., F. Inst. P., Professor Emeritus, Middlesex Hospital; Fellow of University College, London; L. H. CLARK, Ph.D., F. Inst. P., Physicist, Hammersmith and Lambeth Hospitals, AND S. R. PELC, Ph.D., Physicist, Medical Research Council, Radiotherapeutic Research Unit. Second edition, revised, 1950. A volume of 296 pages, with 106 illustrations. Published by Chapman & Hall, Ltd., London. Price 30s net.

In Britain, relations between medical radiologists and radiological physicists are a good deal closer than in this country, largely because they are more familiar with each others' problems. This fact is amply attested to by this book, in which physical phenomena are discussed with a thoroughness and precision which are not likely to be found in American counterparts. Perhaps the best use to which the volume may be put is to serve as a reference work on basic physics as applied to radiology. Its usefulness as a source of practical information is not only limited by local differences in radiological practice, but also by the fact that the revisions in this edition are not as complete as they might have been. As a result, there is little information on recent developments and technics, and much of the material covered is of historical interest only. Some of the apparatus described is not only foreign to modern American practice but very likely to be outmoded in England also. The use of artificially produced radioactive isotopes is much more limited outside the United States, but the information on this subject, given by Russ and his co-workers, is quite scant by most standards. Both new and old definitions of the roentgen unit are given, and the latter will be found if the index is consulted.

It is perhaps unfortunate that this work should be of such restricted usefulness, because it is very well written. While some rearrangement might have simplified the presentation, the style is lucid and there appears to be a remarkable absence of errors or ambiguous statements of any kind.

MALIGNANT DISEASE OF THE FEMALE GENITAL TRACT. By STANLEY WAY, M.R.C.O.G., Gynaecologist to the Newcastle Regional Cancer

Organization; Associate Surgeon, Gynaecological Department, Royal Victoria Infirmary, Newcastle-on-Tyne; Hunterian Professor, Royal College of Surgeons of England, 1948; Blair Bell Lecturer, Royal College of Obstetricians and Gynaecologists, 1948. A volume of 280 pages, with 38 illustrations. Published by The Blakiston Co., Philadelphia, 1951. Price $5.00.

Within the scope of 280 pages the author has presented a concise survey of the malignant neoplasms of the female genital system. The treatment of the subject is clear, pointed, and rational. Information available in standard textbooks is mentioned and well appraised, but many of the details have been purposely omitted to avoid redundancy. Less well understood subjects have been treated in fuller fashion.

Radical vulvectomy is presented in detail. The author's personal experience with carcinoma of the vulva and its treatment is comparatively extensive, and points of interest and value are well emphasized and clearly presented. A modification of the application of radium to the uterine cervix, by the use of plastic molds, is described and illustrated. The suggestion that the upper third of the vagina be removed, as in a radical hysterectomy, when excising the uterus for carcinoma of the fundus is a point well taken. Of particular interest to those treating female genital neoplasms is the emphasis placed upon the possible and usual types of lymphatic spread to be expected from various lesions. This information is explicit and practical.

By mentioning, but not detailing, standard procedures, much space has been saved. This feature adds, rather than detracts from the work, since the reader does not become bogged down with details already known. As a result, we have a readable volume and one which both the practising radiologist and the gynecologist will find of value.

ORAL AND FACIAL CANCER. By BERNARD G. SARNAT, M.D., F.A.C.S., Professor and Head of the Department of Oral and Maxillofacial Surgery, College of Dentistry, and Clinical Assistant Professor of Surgery, College of Medicine and Research and Educational Hospital, University of Illinois, Chicago; Diplomate of the American Board of Plastic Surgery, and ISAAC SCHOUR, D.D.S., Ph.D., Sc.D., Co-ordinator of Cancer Instruction, Professor and Head of the Department of Histology and Associate Dean in Charge of Postgraduate Studies, University of Illinois College of Dentistry, Chicago. With a Foreword by ANDREW C. IVY, Ph.D., M.D., D.Sc., Vice-President in Charge of Chicago Professional Colleges, University of Illinois; Executive Director of the National Advisory Cancer Council. A volume of 300 pages, with 118 illustrations. Published by the Year Book Publishers, Inc., Chicago, Ill., 1950. Price $6.00.

Here is a slender volume, gratifyingly brief, presenting the salient data on facial and oral cancer. It is "designed to serve as a simplified course in the early diagnosis and therapy" of these lesions. In the view of Dr. Andrew C. Ivy, who has written a brief Introduction, it "represents a new period and successful pioneering accomplishment in the professional field of cancer education" and will result in the saving of many lives as a result of the "skilled pedagogic technics" employed by the authors. It is apparent from these statements that this is not a text for the expert; it appears, in fact, to be written for the dentist more than for the physician. The authors take a dim view of radiation therapy in the mouth, to a somewhat disconcerting degree.

DIE KLINISCHE RÖNTGENDIAGNOSTIK DER INNEREN ERKRANKUNGEN. By PROF. DR. HERBERT ASSMANN. Sixth edition. Part I. 420 pages, with 501 illustrations and 10 tables, 1949. Part II. 604 pages, with 859 illustrations, 1950. Published by Springer, Berlin.

Assmann's well known work on the x-ray diagnosis of internal diseases, which first appeared in 1921 and which has been out of print for many years, has now been brought up to date in a sixth edition. Chapters on the newer radiodiagnostic developments, *e.g.*, cardioangiography, have been added. The text is clear and comprehensive. The style of presentation represents the modern German tendency to change from the involved terminology and Latinized syntax so fashionable in the reviewer's medical school years to an easier and more readable style as exemplified by English and French composition. Although several hundred new illustrations have been included, the number of pages has decreased, largely due to the elimination of special bibliographic chapters. The quality of the paper and the excellence of the illustrations and printing reach the high pre-war standard of the Springer publishing house.

[A pertinent question is suggested by a comparison of these outstanding typographical features with the inferior paper and blurred illustrations of some of our more expensive American radiological textbooks. That we could do better is demonstrated by the fine quality and the clear reproduction of roentgenograms in our radiologic journals, which are not surpassed typographically by any European publications and generally are far superior to our bound books in this respect. In this connection it might also be mentioned that an agreement among authors and publishers for the universal use of "negatives" corresponding to the original appearance of the roentgenogram would be welcomed by the majority of readers.]

Assmann's book appears well worthy of translation into the English language. It is the most comprehensive and authoritative foreign text on radiodiagnostics of internal medicine now available.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, John E. Wirth, M.D., 635 Herkimer St., Pasadena 1, Calif.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. D. Anderson, M.D., 420 10th St., Tuscaloosa.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Harold P. Tompkins, M.D., 658 South Westlake Ave. Meets monthly, second Wednesday, County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, Clifford W. Wauters, 701 High St., Auburn. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Charles E. Duisenberg, M.D., 300 Homer Ave., Palo Alto. Meets monthly, second Tuesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Merrell A. Sisson, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:45, January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Paul E. RePass, M.D., 306 Republic Bldg., Denver 2. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Karl C. Corley, M.D., 1835 Eye St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Auditorium.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Nelson T. Pearson, M.D., 1109 Huntington Bldg., Miami. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, Theodore M. Berman, M.D., 350 Lincoln Road, Miami Beach. Meets monthly, last Wednesday 8:00 PM., Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Dudley King, M.D., 35 Linden Ave., N. E. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert C. Pendergrass, M.D., Americus. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Benjamin D. Braun, M.D., 6 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. John's Hospital, Springfield. Meets quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Willard C. Smullen, M.D., St. Mary's Hospital, Decatur.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY, *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clark F. Miller, M.D., Central Maine General Hospital, Lewiston.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*. Richard B. Hanchett, M.D., 705-6, Medical Arts Bldg., Baltimore 1. Meets third Tuesday, September to May.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, James C. Cook, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, Leo A. Nash, M.D., 572 Lowry Medical Arts Bldg., St. Paul 2. Meets in Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Donald S. Bottom, M.D., 510 S. Kingshighway Blvd. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Russell W. Blanchard, M.D., 1216 Medical Arts Bldg., Omaha. Meets fourth Thursday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, L. L. Robbins, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday at the Harvard Club, Boston

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary* Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meets quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Nicholas G. Demy, M.D., 912 Prospect Ave., Plainfield. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meets in January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to May, at 8:45 P.M., Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, John L. Olpp, M.D., 49 Ivy Lane, Tenafly, N. J.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John F. Roach, M.D., Albany Hospital, Albany. Meets quarterly.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, George Gamsu, M.D., 191 S. Goodman St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, P. H. Woutat, M.D., 322 Demers Ave., Grand Forks.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan, M.D., 10515 Carnegie Ave., Cleveland 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, Lawrence Gibboney, M.D., Carew Tower Bldg. Meets first Monday, September to May.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. Todd Jessell, M.D., 224 Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, at 8:00 P.M., University of Oregon Medical School.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Edwin J. Euphrat, M.D., 3500 Fifth Ave., Pittsburgh 13. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., Lincoln Clinic, Lincoln, Nebr. Next annual meeting, Aug. 9–11, 1951, Denver.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Henry E. Plenge, M.D., 855 N. Church St., Spartanburg. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets with State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, John E. Whiteleather, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meets monthly third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Frank M. Windrow, M.D., 1205 Hermann Professional Bldg., Houston 5.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting, Jan. 18–19, 1952, Houston.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. C. Kiltz, M.D., 705 Medical-Dental Bldg., Everett. Meets fourth Monday, October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Theodore J. Pfeffer, M.D., 839 N. Marshall St., Milwaukee 2. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee. Meets in May and with State Medical Society, September.

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ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Digestive System

The Adrenals

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Cerebral Angiography in Neurosurgery. Part I. Angiographic Appearances in Cerebral Tumors. Part II. Angiographic Appearances in Intracranial Aneurysms. J. L. Dowling. Australian & New Zealand J. Surg. **20:** 11–24, August 1950.

After the site of a brain tumor has been ascertained, angiography may permit an estimation of its size and sometimes a very close approximation of the pathological type. The contrast medium may be introduced by either the percutaneous or the open method, and the injection may be made into the carotid system or the vertebral artery. The iodine preparations such as are used in pyelography are preferred to thorotrast.

In the first of his two papers, the author describes the normal findings and the changes indicative of tumor. The latter are of three types: vessel shift, an abnormal vascular pattern, and absence of vessels. There may be displacement of the internal carotid itself or of the anterior and middle cerebral arteries. In the cavernous sinus which has been invaded by neoplastic infiltration from the skull base, the sinuous course of the carotid is straightened by the upward-growing tumor. The displacement of the other two vessels is dependent upon the position of the tumor. Several types of alteration of the vascular pattern are illustrated: a generalized haze due to diffusion of the dye through the capillary bed [the so-called capillary stain], a complete disorganization of the normal pattern, and the coiled mass of vessels characteristic of a cortical hemangioma. Failure of a vessel to fill is a less reliable sign, since it may be due to thrombosis or spasm rather than to tumor invasion.

Meningiomata often show capillary staining as well as vessel shifting. Sometimes a well formed vessel is demonstrable surrounding the tumor. Malignant gliomata are characterized by marked disruption of the normal vascular pattern and the presence of multiple sinusoids. The benign gliomata usually show vessel displacement only, without any unusual vascular pattern. Hemangiomata characteristically show a dense coiled mass of vessels with a large volume of blood flow.

For the demonstration of intracranial aneurysms, which are the subject of the author's second paper, the open method of angiography is preferable. Most intracranial aneurysms involve the circle of Willis or the internal carotid as it traverses the cavernous sinuses. Supraclinoid aneurysms cause ocular signs by pressure on the oculomotor nerve or the visual pathways, while the intraclinoid type may cause pressure changes in the 3rd, 4th, 5th, or 6th nerves. In either type the aneurysm is readily visualized, with filling of the distal vessels.

In the presence of a fistulous communication between the carotid and the cavernous sinus, due to rupture of an infraclinoid aneurysm or trauma, the sinus and possibly some of the veins will be visualized, but the cerebral vessels will not be seen. The hemisphere is supplied almost wholly by the opposite carotid, which fact should be determined before ligation is carried out.

Spontaneous subarachnoid hemorrhage is most frequently due to an intracranial aneurysm involving the main trunks or the branches of the carotid or basilar systems. Its occurrence is a very definite indication for cerebral angiography. If the first side examined is normal, the opposite side should be studied. Should injection show both carotids to be normal, the aneurysm is presumed to lie somewhere upon the basilar system and so is surgically inaccessible.

Twenty-two roentgenograms; 2 drawings.

Zac F. Endress, M.D.
Pontiac, Mich.

Ventriculography of Temporal Tumors. Reinhold Lorenz. Fortschr. a. d. Geb. d. Röntgenstrahlen **73:** 199–212, June 1950. (In German)

For the ventriculographic study of temporal tumors, the author uses anteroposterior and postero-anterior projections, including the so-called half-axial views (chin depressed), as well as right and left lateral films. He regards the half-axial views as of particular value in observation of the temporal horns. He states that distortion and displacement of the ventricular system is caused not only by the size of the tumor, but by the associated edema and swelling of the adjacent brain tissue.

After a general discussion of temporal tumors from the clinical and pathological aspects, the findings on ventriculography are presented as follows:

Tumors in the *anterior portion* of the temporal region show lateral displacement of the anterior horns toward the uninvolved side. The anterior horn of the affected side is depressed from above (by the falx) and often somewhat drawn out to a point. The septum pellucidum is vertical. The temporal horn, although somewhat compressed, is seldom disturbed as to position. The position of the occipital horn is unchanged. The cella media of the uninvolved side is stretched posteriorly toward the affected side.

Tumors in the *posterior portion* of the temporal region show lateral displacement of the anterior horns to the uninvolved side; that of the involved side is somewhat flattened but the lateral border is rounded. The septum pellucidum is vertical. The temporal horn of the involved side is not filled and, if demonstrated at all, is displaced medially and upward. The occipital horn of the involved side is somewhat depressed, and occasionally is not demonstrable. The lateral ventricle on the involved side near the trigone is compressed.

Tumors in the *basilar portion* of the temporal region show lateral displacement of the anterior horn, that of the affected side being flattened from above. The septum pellucidum is vertical. The temporal horn is displaced upward and medially; very often its anterior portion is not filled. The occipital horn is unchanged in position. The cella media shows a slanting course.

Tumors in the *region of the sylvian fissure* cause lateral displacement of the frontal horns; that of the affected side is compressed and the lateral border is rounded. The septum pellucidum is vertical. The temporal horn of the affected side is not filled, except in the posterior portion, which is displaced medially (appearance somewhat modified by location of tumor). The occipital horn of the affected side is partially filled and depressed downward. The cella media is drawn obliquely.

Tumors in the *medial portion* of the temporal region produce lateral displacement of the frontal horns, that of the involved side being flattened and the lateral contour rounded. The septum pellucidum is slanted toward the affected side, and bent. The temporal horn on the affected side is displaced somewhat laterally and collapsed. Very often it is not filled. It may be displaced downward, corresponding to the direction of tumor growth. The third ventricle is arched. The cella media is elevated and slanted.

Thus, by observation and indirect localizing signs, it is often possible to obtain an accurate localization of the neoplasm.

Nineteen roentgenograms; 5 drawings; 3 photographs.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Intracranial Aneurysms. C. Hunter Shelden, Robert H. Pudenz, and Leland E. Brannon. Arch. Surg. **61:** 294–302, August 1950.

The high mortality which accompanies the initial rupture of an intracranial aneurysm justifies the use of cerebral angiography in any patient in whom such a vascular lesion is suspected. Over three-fourths of the cerebral aneurysms occur on the anterior half of the circle of Willis, which is surgically the most accessible.

The most definite indication of an intracranial aneurysm is an intracranial bruit, and arteriography should be carried out in all patients in whom it is present. Unilateral proptosis, particularly in association with engorgement of the conjunctival and retinal veins, is most commonly due to an arteriovenous aneurysm involving the carotid artery and the cavernous sinus, by means of which arterial blood is forced through the ophthalmic veins. Occasionally adequate roentgen examination will disclose evidence of erosion of the inferior portion of the clinoid process on one side or unilateral erosion of the sella turcica. Along with bony erosion, linear streaks of calcification may be visible, owing to the presence of calcium in the aneurysmal wall. One of the most frequent ocular lesions observed with intracranial aneurysm is paralysis of the third nerve, which may occur alone or in conjunction with other localizing evidence. Although headache is not a primary symptom of intracranial aneurysm, the presence of recurrent focal migraine-like headache over a period of many years is sufficient to allow one to consider the possibility of that diagnosis.

Rupture of an aneurysm seldom leaves any doubt that a serious intracranial catastrophe has occurred. The initial symptom is usually sudden, severe headache, frequently in the occiput, associated with marked meningismus and the presence of blood in the subarachnoid space. It is the authors' policy to carry out arteriography as soon after the initial hemorrhage as the condition of the patient permits, usually somewhere between the tenth and twenty-first day in the hospital. Bilateral arteriography may be necessary in the absence of positive neurologic signs, the procedure being carried out on the right side first, since this represents the hemisphere with the least localizing functions.

The operative treatment of cerebral aneurysm is discussed. Technical advances are constantly increasing the scope of this aspect of neurosurgery, and it is anticipated that in the near future many lesions now considered inoperable will be amenable to successful management.

Six illustrations, including 3 arteriograms.

Calcified Intracerebral Hematoma. Case Report and Review of the Literature. Frank W. Lusignan and Glen O. Cross. Ann. Surg. **132:** 268–272, August 1950.

A case of calcification in a hematoma of the right parietal lobe, 3 cm. beneath the surface of the cortex, is reported. Clinically the symptoms were compatible with an intracranial mass, and a mottled calcium deposit in the right parietal area was demonstrable on the plain films. Venograms showed displacement of abnormally large veins about the area of calcification, but arteriograms were normal. Air studies demonstrated a ventricular shift away from the involved side. The hematoma was evacuated and the patient remained well after two years.

Four previously reported cases of operatively removed intracerebral hematomas are reviewed.

The coexistence of intracranial calcifications with facial nevi has been discussed by others. The occurrence of a lipoma of the scalp in the authors' case is mentioned as further emphasizing the association of ectodermal variations with vascular malformations of the central nervous system.

Six roentgenograms; 6 drawings.

CORNELIUS COLANGELO, M.D.
Chicago, Ill.

Osteitis Fibrosa Cystica Localisata of the Skull. John Paget, Geoffrey Fricker, and Adrien Ver Bruggen. J. Neurosurg. **7:** 447–450, September 1950.

Localized osteitis fibrosa cystica in the skull is rare. The x-ray picture is that of an area of bone destruction with a surrounding sclerotic margin. It must be differentiated from metastatic tumor, and a case is reported in which surgical exploration was necessary to make this distinction.

The patient, a 13-year-old girl, had had epileptic seizures of the petit mal variety for five years. At the beginning of the attacks, neurologic findings were within normal limits except for a bilateral nystagmus and an ataxic gait. Roentgen examination of the skull, including pneumoencephalography, was normal. During the next five years the patient had occasional seizures. When she was seen at the age of thirteen, roentgenograms of the skull showed a single rounded area of destruction with a sclerotic margin in the left frontoparietal area. An electroencephalogram was interpreted as being within normal limits. Pneumoencephalographic findings were normal, as were roentgenograms of the chest, spine, and long bones. Because of the possibility of metastatic tumor, surgical exploration was carried out. A roughly circular segment of hyperostotic bone measuring 4 cm. in diameter and 1 cm. in thickness was removed. The microscopic diagnosis was osteitis fibrosa cystica.

Three roentgenograms; 1 photomicrograph.

Treatment of Empyema of the Sella Turcica of Sphenoid Origin. Joseph R. Rongetti and James T. Daniels. Arch. Otolaryng. **52:** 166–171, August 1950.

Empyema of the sella turcica arising from infection in the sphenoid sinus has been reported previously only once. The authors' patient had severe headache, vomiting, diplopia, marked thirst, and increased urinary output. Neurologic examination revealed concentric constriction of the visual fields, ptosis of the right eyelid, and paralysis of the lateral rectus on the

right. Spinal tap showed clear fluid with 21 granulocytes per cubic centimeter. Roentgenograms of the skull revealed bone erosion and destruction of the sella turcica. A ventriculogram demonstrated symmetrically dilated lateral ventricles without displacement. Craniotomy showed the diaphragma sellae to be bulging and boggy. When a needle was passed through the diaphragma, thick pus was withdrawn. The operation was discontinued.

On otolaryngologic examination a thick creamy postnasal drip was observed. The left sphenoid sinus was entered with a cannula, which passed through the soft posterior sphenoid wall into the sella turcica. Pus was obtained from the sphenoid ostium. An ethmoidectomy and uncapping of the anterior sphenoid wall were done. A mushroom catheter was inserted into the resultant cavity. Penicillin administration by injection and by drip through the catheter was instituted and the patient made a rapid recovery.

Six roentgenograms. PAUL W. ROMAN, M.D.
Baltimore, Md.

THE CHEST

Vertical Tomography of the Thorax. D. W. Crombie and Paul M. Andrus. Am. Rev. Tuberc. **62:** 170–175, August 1950.

A series of 904 lungs were radiographed by means of an upright tomographic system and cavitation was found in 398 of them; 190, or nearly one-half, showed demonstrable fluid levels within the cavity. Criteria for classifying dependent line shadows as fluid levels were as follows: (*a*) knife-edge sharpness and straightness, (*b*) strictly horizontal direction, (*c*) beginning and ending strictly at the margins of the suspect cavity.

The authors feel that with this procedure there is a definite increase in tuberculous cavity identification because this position is similar to the one used routinely and because demonstration of a fluid level makes the diagnosis unequivocal or nearly so.

Five roentgenograms; 2 tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Contribution of Roentgen Tomography to the Demonstration of Bronchial Carcinoma. Eugen Muntean. Fortschr. a. d. Geb. d. Röntgenstrahlen **73:** 150–155, June 1950. (In German)

X-ray diagnosis of bronchial carcinoma depends upon the demonstration of bronchial obstruction with characteristic irregularity of outline in the region of stenosis, a mass, and atelectasis. There is often a cone-shaped or radial extension from the periphery of the tumor shadow. The atelectasis is demonstrated by tomography as a homogeneous shadow with an irregular border. Benign intrabronchial lesions give a rounded impression with a sharp border at the point of obstruction. Pressure of an outside mass causes separation or compression of the smaller bronchial divisions in the immediate region of the lesion. It is often possible to differentiate between the benign types of bronchial obstruction and the irregular step-like or indented border characteristic of a malignant lesion.

The author believes that in many cases it is possible to obtain sufficient evidence of a malignant lesion by tomographic study without the use of bronchograms; on the other hand, both methods may fail to establish a positive diagnosis. Tomography is of special value when bronchography is contraindicated because of iodine sensitivity, a hyperthyroid state, an active open tuberculous lesion, hemoptysis, advanced kidney disease, circulatory failure, or extreme age. It is helpful, also, in showing cavitation within the mass and aids in identifying metastases in the mediastinal lymph nodes. In the author's experience the method finds one of its chief applications in the demonstration of mediastinal metastasis, which is important in estimating the chances of surgical success.

Thirteen roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Roentgen Diagnosis of Bronchial Carcinoma as Prerequisite to Pneumonectomy. A. Leb. Fortschr. a. d. Geb. d. Röntgenstrahlen **73:** 141–150, June 1950. (In German)

Often only a presumptive diagnosis of bronchial carcinoma is possible roentgenologically. However, any fairly homogeneous shadow in a patient past forty years of age should be regarded as probable tumor unless it can be proved otherwise. All possible means of investigation must be used, including bronchography, tomography, fluoroscopy, especially with barium-filling of the esophagus, and a therapeutic test of the response of the lesion to relatively small doses of radiation.

Bronchography is carried out by means of a water-soluble contrast medium, which is guided into the questionable stem bronchus by catheter, allowing excellent filling of the area involved, with complete resorption of the dye in a few hours. The author uses Joduron B, and his illustrations show the excellent diagnostic quality of the pictures thus obtained.

Tomography is extremely valuable in demonstrating the relationship of the bronchi and tumor nodules to the thickened hilar structures and in identifying pressure or stenosis within the bronchial lumen.

Fluoroscopy indicates pressure on the trachea or esophagus and fixation of the mediastinal structures.

As a therapeutic test, doses of between 60 and 80 r, given every second day, often produce rapid resolution of an inflammatory area. This is occasionally a very valuable differential point between a simple inflammatory lesion and tumor.

The demonstration of distal metastasis, secondary involvement of the mediastinal structures, or atelectasis is considered strong presumptive evidence of tumor. In a considerable number of cases, the author found that the distant metastatic lesions were recognized before the primary focus was identified.

During an observation period of eighteen months, 137 cases of bronchogenic carcinoma were followed, 42 being autopsied or proved by operation. Of these, 86 per cent were diagnosed roentgenologically, 60 per cent without question.

The basis for surgery lies in (1) not placing reliance upon any single procedure but rather upon a correlation of data obtained by all available methods; (2) as prompt a diagnosis as possible, with completion of all diagnostic measures, including the therapeutic test of radiation, within eight days; (3) recognition of inoperable cases by appropriate procedures; (4) improvement of bronchographic technic by use of a water-soluble medium, permitting serial bronchograms

at short intervals. The repeated demonstration of bronchial stenosis is a valuable indication of tumor invasion.

Sixteen roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Simultaneous Occurrence of Pulmonary Tuberculosis and Cancer. Eugen Muntean and Rudolf Amon. Fortschr. a. d. Geb. d. Röntgenstrahlen **73:** 156–163, June 1950. (In German)

A difficult diagnostic problem arises where there is a suspicion of associated cancer and tuberculosis within the lung. It is possible that an old tuberculous lesion may contribute toward the development of cancer, but there is no uniform opinion on this point.

The cases observed are divided into three groups:

Group 1: Cancer associated with an active tuberculous lesion. Very probably these conditions are merely simultaneous and are not directly related from an etiologic standpoint. Relatively few cases are seen, as ordinarily patients with active tuberculosis do not live to reach a cancer age.

Group 2: Cancer developing within an old indurated tuberculous scar or in the wall of a cavity. It is possible in such cases that the old tuberculous focus may act as a predisposing underlying factor. Usually rather small areas in the periphery of the lung are involved. Often there is scar tissue attachment to the pleura but no carcinoma is demonstrable in the pleura.

Group 3: Cancer developing in an inactive tuberculous focus, apparently reactivating it.

During a period of eighteen months, the authors observed 86 carcinomas of the lungs and bronchi, 15 of which were within tuberculous areas. Nine of the 15 were associated with active tuberculosis, 2 with inactive tuberculosis, and 4 were in tuberculous scar tissue. Illustrative cases are reported.

Eleven roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Primary Hodgkin's Disease of the Lung. Krikor Yardumian and Leonard Myers. Arch. Int. Med. **86:** 233–244, August 1950.

In a collected series numbering 125 cases of Hodgkin's disease, 37.6 per cent of the patients were found to have pulmonary involvement (Am. J. M. Sc. **191:** 780, 1936. Abst. in Radiology **28:** 124, 1937). The lesions may be lobar, lobular, or miliary in distribution. Differentiation from sarcoidosis, tuberculosis, bronchopneumonia, and unresolved pneumonia may be impossible, particularly when there are secondary changes of infection, consolidation, abscess formation, and atelectasis. The clinical course, the changing x-ray picture, and the response to x-ray therapy help to establish the diagnosis in the absence of a lymph node biopsy.

Primary Hodgkin's disease of the lung is rare and probably arises from the lymph tissue in the parenchyma and the bronchial submucosa. In the case presented by the authors, the initial chest film revealed a diffuse increase in the lung markings compatible with chronic bronchitis, congestion, pneumoconiosis, old tuberculosis, fungous infection, and alveolar carcinomatosis. One year later the chest film showed a nodular infiltrate which was confluent in two large areas and which resembled an atypical tuberculosis or a pneumonia. The clinical findings at this time were cough, fever, dyspnea, hemoptysis, hepatomegaly, several small inguinal and axillary nodes, and emaciation. Liver biopsy showed a chronic hepatitis, and biopsy of an axillary node showed a "chronic toxic lymphadenitis with fibrosis," but despite extensive studies, an antemortem diagnosis was not made.

The gross postmortem diagnosis was carcinoma of the lungs with bilateral lobar pneumonia, but microscopically Hodgkin's disease was seen involving the peribronchial areas and infiltrating the alveolar walls and interalveolar spaces. Large areas of secondary inflammation with polymorphonuclear leukocytes filling the alveoli resembled pneumonic consolidation. No lymph nodes were involved, but occasional Hodgkin's nodules were found in the liver.

Since even the gross postmortem diagnosis was in error in this case, obviously the antemortem diagnosis is difficult. The authors include a pertinent and helpful quotation (Hartfall: Guy's Hosp. Rep. **82:** 55, 1932): "When a clinical condition suggests tuberculosis and x-ray suggests neoplasm of the lung, the observer should consider lymphogranuloma (Hodgkin's disease of the lung)."

Two roentgenograms; 4 photomicrographs.
CORNELIUS COLANGELO, M.D.
Chicago, Ill.

The Shrunken Right Middle Lobe, with Reference to the So-Called "Middle Lobe Syndrome." Eli H. Rubin and Morris Rubin. Dis. of Chest **18:** 127–145, August 1950.

The authors give short histories of 16 cases of shrunken right middle lobes, unassociated with neoplasm, pneumonia, foreign body aspiration, or tuberculosis, in which conditions the middle lobe involvement is incidental to a more widespread process. In 7 of these cases there was an associated bronchiectasis. The authors advise postero-anterior and lordotic views of the chest, supplemented by planigraphy, bronchography, and bronchoscopy as necessary, to aid in arriving at a diagnosis.

In the lateral projection, it is occasionally possible to discern a triangular density within a large quadrilateral mass; more often the atelectatic lobe is roughly triangular. If the middle lobe is shrunken as a result of bronchial obstruction, and its volume greatly reduced, the lobe may be represented by a narrow opacity not much wider than a rib. The configuration of the shrunken lobe is modified by the shape of the chest, the presence of pleural adhesions, and the condition of the adjoining lobes.

Obstruction of the lateral division of the right middle lobe bronchus is manifested in the postero-anterior projection by a diffuse clouding, extending into the lower right lung field, with a clear zone between it and the heart; in the lateral projection it appears as a triangular shadow situated low and posteriorly.

With obstruction of the medial branch of the right middle lobe, the postero-anterior projection shows an irregular density adjacent to the right border of the heart; in the lateral projection the density appears quadrilateral, lying anteriorly (immediately behind the sternum) and below the horizontal fissures.

Most of the patients give a history of moderate cough and expectoration for many years. At times symptoms may be more severe, including croupy spasmodic cough, wheezing, and increased expectoration, not foul unless

secondarily infected. Recurring hemoptyses may be the presenting symptom.

From an analysis of their cases the authors conclude that the causes lie in cicatrizing tuberculous lymph nodes constricting the middle lobe bronchus. In some, the shrunken lobe is the seat of bronchiectasis; in others, there is a tuberculous involvement of the bronchus and lobe.

Eighteen roentgenograms; 1 photograph.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Pneumokoniosis in Queensland Foundries. Douglas Gordon. M. J. Australia **2:** 217–224, Aug. 5, 1950.

A study of pneumoconiosis as observed in iron and steel foundries in Queensland, Australia, is presented. The number of foundries surveyed was 76 and the number of employees 1,118, of whom 388 had been employed in sufficiently hazardous jobs for periods long enough for the development of the disease. Of this latter group, 359 co-operated in the project. For these, occupational and medical histories were available and they were studied clinically and roentgenologically.

Thirteen cases of silicosis were discovered, of which 10 were early. In 8 other instances the possibility of silicosis was considered but eventually was regarded as doubtful. Most of the patients with a positive diagnosis were elderly men who had worked in foundries for many years.

The author stresses the point that radiologic evidence of silicosis may bear no relation to disability in a given case, and also that a patient with silicosis should not lightly be told to seek other employment. Rather the job should be made safe for the man to continue to work at it, as in most instances he will be too old to learn another trade or to do hard manual labor.

Many foundry jobs are less hazardous now than formerly because of the use of less dangerous material and better ventilation, but a few still present a serious problem. The incidence of silicosis found in this survey was not thought to be high in comparison with others.

Five tables; 3 graphs. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Further Observations on Histoplasmosis. Mycology and Bacteriology. Michael Furcolow. Pub. Health Rep. **65:** 965–994, Aug. 4, 1950.

Infection with *Histoplasma capsulatum* as manifested by sensitivity to histoplasmin and frequently by calcification in the lungs or hilar lymph nodes is known to be particularly prevalent in the states bordering the Mississippi and its larger tributaries. In the Kansas City area 80 per cent of the population are positive reactors.

Bunnell and Furcolow, in an earlier publication, reported on 10 cases from the Kansas City area (Pub. Health Rep. **63:** 299, 1948). Six additional cases are presented here and further information on the 10 earlier cases is supplied. In the search for the etiologic agent, sputum, gastric washings, tissue biopsies, and bone marrow aspirations were used. Autopsy material was studied by microscopic sections, cultures, and animal inoculations. The combined observations indicate that the fungus may be found in a wide variety of clinical conditions without reference to a diagnosis of histoplasmosis.

The clinical symptoms in the 16 cases included fever, hepatosplenomegaly, cough, dyspnea, weight loss, chills, hoarseness, draining supraclavicular nodes, and arthritis. Fifteen cases showed some evidence of pulmonary parenchymal involvement. Two of these had miliary infiltrates in the lungs, and both showed miliary calcifications four years later. Granular or scattered pulmonary infiltrates were present in 4. Pulmonary changes with or without cavitation strongly suggestive of tuberculosis were noted in 6 cases. In 2 instances carcinoma of the larynx had to be excluded, the *Histoplasma* having caused a granulomatous growth within the larynx. In the entire series only 2 patients were shown to have co-existing tuberculosis.

Skin tests and complement-fixation tests were positive in 13 of the 16 cases. In each of the 3 cases with negative skin and complement-fixation reactions, widespread histoplasmosis was found in the tissues at autopsy. Of the 16 patients, 5 have recovered; 2 are classed as ill with the disease; the others have died.

The paper is an excellent one and should be read in its original form.

Twenty roentgenograms and a table of the clinical and laboratory findings in the 16 cases accompany the text. ISRAEL BERGER, M.D.
University of Louisville

Report of a Case of Localized Bronchopulmonary Aspergillosis Successfully Treated by Surgery. Raymond Yesner and Alfred Hurwitz. J. Thoracic Surg. **20:** 310–314, August 1950.

An ovoid area of increased density, 4 cm. in diameter, near the left hilar region, resembling a neoplasm radiologically, proved to be pulmonary aspergillosis. Viable organisms were recovered from the surgical specimen. Nine days after resection of the left lower lobe the patient, a man of thirty-five, was discharged. He had no symptoms when seen seven months later. This is said to be the third case of localized bronchopulmonary aspergillosis which has been successfully treated by surgery.

Aspergillosis of the lungs develops in those exposed occupationally to inhalation of grain dust, as salesmen, poultry men, bird fanciers, etc. The authors' patient had worked in a chicken-feed store and on a chicken farm. Roentgenographic differentiation from tuberculosis, other fungous diseases, and neoplasms is necessary.

Four illustrations, including 1 roentgenogram.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Mucor-Mycosis of the Lung. J. D. Murphy and S. Bornstein. Ann. Int. Med. **33:** 442–453, August 1950.

In a 40-year-old farmer admitted to the hospital with a diagnosis of tumor of the lung, roentgen examination showed a circular area of density in the outer zone of the left third interspace, containing a central core of laminated calcium deposits. The diagnoses considered were a solitary caseous tuberculous lesion which had undergone partial calcification, a neoplasm of the pleura or of the intercostal nerves, or possibly a fungous or parasitic infection. Thoracotomy was performed and the tumor was removed. The pathologic diagnosis was "mucor-mycosis (calcified lesion)."

Mold infections of the lung are rare and are more frequently due to Aspergillus than to Mucor.

Nine illustrations, including 1 roentgenogram.

Chronic Primary Friedländer Pneumonia: Report of a Case with Prompt Clinical and Roentgen Cure Following Streptomycin Therapy. John L. Switzer, Joseph Cohen, and Lyle A. Baker. Am. Practitioner **1:** 941–943, September 1950.

The authors report a case of primary Friedländer pneumonia treated by streptomycin. The initial roentgenogram revealed a multilocular abscess in the right upper lobe with a horizontal fluid level indicative of chronicity. Thirteen days later, following streptomycin therapy, there was roentgen evidence of decrease in the abscess cavity, and subsequent serial films showed complete resolution of the process.

Seven roentgenograms; 1 chart.

Eroding Calcified Mediastinal Lymph Nodes. Shea Halle and Oscar Blitz. Am. Rev. Tuberc. **62:** 213–218, August 1950.

Two cases of eroding calcified nodes in the right hilus are presented. In each there was recurrent hemoptysis; in one, severe pain and recurrent hemoptysis led eventually to surgical extirpation of the lesion with resultant alleviation of symptoms.

When calcified hilar nodes erode bronchi, compression plus local inflammation may result in stenosis or perforation of the bronchus. With perforation there may be extrusion of calcific masses into the lumen. When the masses are large, atelectasis may occur on an obstructive basis, with not infrequent development of suppurative disease peripheral to the site of obstruction.

Awareness of the syndrome, plus the presence of recurrent hemoptysis without other cause, atelectasis, wheezing, cough, and persistent mediastinal pain, which may be severe, should lead to roentgen studies and bronchoscopy, which will determine the nature of the process before perforation. Treatment is conservative in many instances, but surgical removal is indicated in the presence of severe repeated hemorrhage, progressive bronchial stenosis, or severe pain, or in any other situation where the lesion threatens the general welfare of the patient.

Overexposed roentgenograms of the chest are sometimes necessary to visualize the calcification. Planigrams will show the relationship of the mass to the bronchial tree and will also demonstrate the calcification.

Six roentgenograms. JOHN H. JUHL, M.D.
University of Wisconsin

Neurofibrosarcoma of the Anterior Mediastinum. Surgical Removal. Lew A. Hochberg, E. Harrison Griffin, and Alfred Bicunas. J. Thoracic Surg. **20:** 315–320, August 1950.

A case is reported in which a superior anterior mediastinal mass extending upward into the neck was revealed by x-ray. The lateral borders were sharply outlined and smooth. The trachea was displaced to the right. No pulsations were demonstrable kymographically. The esophagus was displaced dextrally. The patient, a 63-year-old man, was dyspneic, orthopneic, and cyanotic. The tumor was successfully removed as an emergency measure to relieve respiratory distress. The clinical diagnosis was either retrosternal thyroid or a primary anterior mediastinal tumor. The histologic diagnosis was neurofibrosarcoma.

Only 2 reports of anterior mediastinal neurogenic tumors were found in a recent review of the literature (Thompson, J. V.: Internat. Abst. Surg. **84:** 195, 1947), though ganglioneuromas, fibroblastomas, neurofibromas, and neurinomas have been described in the posterior mediastinum. Symptoms are predominantly neurologic, pulmonary, or manifestations of increased pressure. Benign tumors often reach great size without producing symptoms. Severe intercostal pain is common in malignant tumors. Neither benign nor malignant neurogenic mediastinal tumors respond to radiation therapy.

Five illustrations, including 2 roentgenograms.
DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Tumors of the Thymus. William D. Seybold, John R. McDonald, O. Theron Clagett, and C. Allen Good. J. Thoracic Surg. **20:** 195–214, August 1950.

This report is based upon 45 cases of thymoma—*i.e.*, a tumor of the thymus arising from both the epithelial (reticulum) and thymocytic elements of the thymic parenchyma—seen at the Mayo Clinic in the period 1935–39. Thirty-four of these were associated with myasthenia gravis. With a single exception they were located in the anterior mediastinum.

Knowledge of the size and location of a thymic tumor, obtained from fluoroscopic and radiographic observations, may determine the surgical approach. The roentgenologic appearance is not sufficiently characteristic to permit differentiation from other tumors of the mediastinum, but a mass in the anterior mediastinum in a patient with myasthenia gravis is almost certainly a thymoma. The tumor is usually round or oval and sharply delineated from the surrounding tissues. In some instances, however, it may be somewhat flat and lie in close proximity to the anterior surface of the pericardium, appearing as a bulge projecting forward from the cardiac shadow into the anterior mediastinum. Sufficient calcium to be apparent roentgenologically was present in 13 of the authors' 45 cases. Seventy-five per cent of the tumors in the series had a fibrous capsule. The others invaded the pericardium, pleura, lungs, or great vessels, but no evidence was obtained of lymphatic or hematogenous spread. Cytologically, the encapsulated and invasive tumors appeared identical. Lateral chest views often give evidence of tumor when a frontal view is noninformative.

Roentgen therapy was given 12 patients with myasthenia gravis in whom a diagnosis of thymic tumor was made. Ten showed no evidence of change in size of the tumor. Nevertheless, intensive roentgen therapy is advocated for tumors which cannot be completely removed surgically. Benefit appeared to accrue in some patients.

Eight roentgenograms; 14 photomicrographs; 4 photographs; 7 tables. DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Chronic Obstruction of Major Pulmonary Arteries. Douglas Carroll. Am. J. Med. **9:** 175–185, August 1950.

Massive obstruction of major pulmonary arteries results most frequently from embolism or thrombosis. Death usually occurs before the development of

chronic cor pulmonale. When patients do survive the obstruction, the clinical picture is characterized by cyanosis, dyspnea, orthopnea, polycythemia, right-sided heart failure, and right axis deviation on the electrocardiogram. Physical and roentgen examination of the heart and lungs may reveal little of note, and establishing the diagnosis during life may be extremely difficult.

Five cases of chronic cor pulmonale resulting from obstruction of pulmonary arteries are reported. One case appeared to have resulted from local thrombosis, the others from embolism. There was necropsy confirmation of the diagnosis in all but one instance. In the fifth case a biopsy of the left pulmonary artery showed it to be thrombosed. On right heart catheterization, high pressures with low cardiac outputs were found in 2 cases. In one case a new sign was observed in the chest roentgenogram which may be of help in making the diagnosis of complete obstruction of a pulmonary artery, namely, absence of vascular markings in the left lung field. A similar finding has been described in congenital heart disease (Danelius: Am. J. Roentgenol. **47:** 870, 1942). This abnormality was also evident on the angiocardiogram.

Two roentgenograms; 1 electrocardiogram; 1 table.

Pulmonary Stenosis with Patent Foramen Ovale. Nelson K. Ordway, Louis Levy, II, Albert L. Hyman, and Richard L. Bagnetto. Am. Heart J. **40:** 271–284, August 1950.

The authors report their findings in the study of a 22-year-old Negro male, who was known to have had cardiac disease since childhood, with exertional dyspnea. The blood pressure was 140/98 mm. Hg in the right arm, 135/95 in the left arm, 155/110 in the left leg. Roentgen examination showed "abnormally clear lung fields, concavity of the pulmonary arc of the left cardiac border, a prominent, non-pulsating pulmonary artery below the aortic knob, and enlargement of the right ventricle." Angiocardiograms revealed "delayed emptying time of the right ventricle, with contrast medium still in the right ventricle and pulmonary artery in the twelve-second plate. Dilatation of the pulmonary artery was demonstrated. At each interval following injection of the dye the pulmonary artery was better visualized than the aorta."

Twice during the terminal months of the patient's illness, arterial puncture and cardiac catheterization were carried out. During the first catheterization, the tip of the catheter was passed with difficulty into the pulmonary artery. The procedure was terminated because the patient became extremely dyspneic and apprehensive. At a later date the pulmonary artery was catheterized without untoward incident. Values for blood oxygen thus obtained showed arterial anoxemia and a wide arteriovenous difference. Low pressure in the pulmonary artery and extremely high right ventricular systolic pressure (177) indicated stenosis of the pulmonary valve. A diagnosis of tetralogy of Fallot was made. The patient died before any surgical procedure was attempted.

Postmortem examination revealed an enlarged heart, right auricular and ventricular hypertrophy and dilatation, minimal left ventricular hypertrophy, and fusion of the pulmonary cusps resulting in a diaphragm with a 2.5-mm. central opening. "The foramen ovale was closed by a thick membrane which was unattached anteriorly and overlapped the edge of the foramen in such a way as to permit the tip of the little finger to pass between the two atria. Circumference of the tricuspid valve was 12.5 cm.; of the pulmonary valve, 4 cm.; of the mitral valve, 10.5 cm.; and of the aortic valve, 6 cm."

There was no interventricular septal defect and no overriding aorta. This might have been suspected from the angiocardiographic examination, with the long delay of contrast substance in the right ventricle and the poor visualization of the aorta; also, from the difference between the right ventricular and systemic systolic blood pressures.

Oxygen studies on arterial blood revealed a right-to-left shunt equal to 60 per cent on the first test and 68 per cent six months later. The oxygen saturation of pulmonary venous blood was 94 and 92 per cent respectively. The arterial anoxemia was attributed to the shunting of the venous blood through the foramen ovale from the right to the left auricle.

A lower oxygen content of blood from the pulmonary artery than in the right ventricle and superior vena cava was observed when there was partial occlusion of the stenotic pulmonary valve by the catheter. This is explained by an increase in the magnitude of the shunt from right to left through the foramen ovale. The increased admixture of venous with arterial blood brings about a reduction in the oxygen content of the arterial blood, and this, in turn, as long as the arteriovenous oxygen difference remains unchanged, effects a lower venous oxygen content.

"From the fall in pulmonary arterial oxygen content produced by the passage of the catheter through the pulmonary valve it is possible to calculate blood flow through the valve, through the foramen ovale, and through precapillary anastomoses between bronchial and pulmonary arteries."

Illustrations and a formula for blood flow are included.

Six figures, including 7 roentgenograms; 3 tables.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Roentgenological Studies of Experimental Pulmonary Embolism Without Complicating Infarction in Dog. Sven Roland Kjellberg and Sten-Erik Olsson. Acta radiol. **33:** 507–514, June 1950.

The authors quote Carlotti *et al.* (J. A. M. A. **134:** 1447, 1947. Abst. in Radiology **51:** 126, 1948) to the effect that one must distinguish between pulmonary embolism and pulmonary infarction, since they are often not synonymous. In the presence of a normal circulation, an obstructive embolus in the pulmonary artery does not give rise to an infarct. This is thought to be due to the double system of circulation, with its numerous anastomoses: the bronchial arteries caring for the nutrient supply and the pulmonary for the gaseous exchange associated with respiration.

There has been some difference of opinion as to whether or not it is possible to obtain roentgen evidence of pulmonary embolism uncomplicated by actual infarction. Westermark in 1938 (Acta radiol. **19:** 357, 1938. Abst. in Radiology **32:** 634, 1939) and later Shapiro and Rigler in 1948 (Am. J. Roentgenol. **60:** 460, 1948. Abst. in Radiology **53:** 446, 1949) are quoted as having indicated definite changes in the presence of embolism without evidence of infarction.

In order to test the above contention the authors carried out experimental studies in dogs.

Under nembutal anesthesia and after control films had been obtained of the chest in frontal and oblique projections, an artificial embolus was introduced through the exposed external jugular vein. In 4 instances the embolus consisted of a glass cylinder partly filled with barium sulfate. In 4 animals a substance which is pliable and soft at body temperature but is firm at room temperature was used. This consisted of pellets 3 to 4 cm. long and of different widths. Each pellet was encased in a very thin rubber membrane to prevent fragmentation. In order to verify roentgenologically that the obstruction was complete, a contrast medium (thorotrast) was injected in one dog after the embolus was lodged.

Postmortem examination was done on all the animals; the site of the embolism was determined and its obstructive character verified.

Of the 8 animals, none showed any changes on the roentgenogram after the lodging of the embolus. Vascular design was equally prominent on both sides, before and after the embolic phenomenon. Neither appreciable diminution in the caliber of the artery on the peripheral side of the embolus nor any abrupt interruption of the vascular design was seen. No local emphysema or other lung changes were observed. In all instances the time of observation was two to four hours after the embolus was at rest.

In the single case in which a contrast medium was injected after the introduction of the artificial embolus, a definite difference between the vascular design within the blocked area and the rest of the lungs was observed.

In the one case where the chest was opened and the lungs were studied *in situ* and respiration was continued with additional pressure, no changes could be seen after the introduction of the embolus.

The authors summarize their experimental observations by indicating that no roentgenologic changes in the lungs are observed in uncomplicated pulmonary embolism in the dog. They go still further by stating that no infarction will occur so long as the circulation through the bronchial artery is undisturbed.

Seven roentgenograms; 4 photographs.

I. MESCHAN, M.D.
University of Arkansas

Experimental Massive Pulmonary Collapse. W. W. Coulter, Jr. Dis. of Chest **18:** 146–153, August 1950.

Obstruction of the air passage supplying a unit of lung which does not communicate with another air passage will produce atelectasis. This is due to absorption by the body fluids of the gases contained in that segment of lung. Ordinarily, the process of collapse requires a considerable length of time. Rapidly occurring collapse has been observed, however, and it has been suggested by Jackson (J. A. M. A. **95:** 639, 1930. Abst. in Radiology **16:** 93, 1931) that this is due to the presence of a one-way valve in the bronchus. Because the anatomy of the lung does not favor an active collapse (no musculature about the alveoli), and does favor a passive collapse, the author decided to investigate the validity of Jackson's suggestion.

A rubber plug was inserted into the main bronchus of the right diaphragmatic lobe of a 10-kg. dog. A roentgenogram of the chest forty minutes later showed no perceptible signs of collapse.

The author constructed a one-way valve, permitting air to escape and none to re-enter the lung, and this was inserted as a plug in the left main bronchus of a 10-kg. dog. Signs of collapse were present four minutes later. Roentgenograms of the chest made thirteen and twenty-nine minutes later showed progressive collapse, and at the end of forty-nine minutes it was almost complete. Similar experiments did not always result in immediate collapse, but this was thought to be due to the inefficiency and unreliability of the valve used. When the valve began to work properly, collapse occurred, and quite rapidly. This is explained on the basis of a potential valve becoming an actual valve.

The author comments on the presence of bronchial breathing heard over atelectatic lung. This he believes to be transmitted. He cites two instances: in one with an atelectatic right upper lobe the transmission was from the trachea; in the second the transmission was from a diseased left upper lobe, through an atelectatic lower lobe, to the chest wall.

Four roentgenograms; 1 drawing.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Heart Volume in Normal Infants. A Roentgenological Study. John Lind. Acta radiol., Suppl. LXXXII, 1950.

Lysholm and Jonsell's modification of the Rohrer-Kahlstorf method was utilized to determine heart volumes in 293 healthy children under two years of age. A control study involving postmortem physical determination of heart volumes and correlation with roentgenographic measurements was performed on 27 subjects, using Rohrer-Kahlstorf's factor of 0.63.

Respiration and cardiac phase were found to cause a significant variation in cardiac size but may be disregarded in practical application of the method.

The anteroposterior and lateral views of the chest are made simultaneously. Two films are placed at right angles, one under and the other at the side of the child. Corresponding to the two films are two tubes, each placed at a fixed target-film distance of one meter. The films are over-penetrated to insure a distinct cardiac outline.

The long diameter (LD) is measured from the base of the vessel shadow on the right side of the heart to the apex. The broad diameter (BD) is measured from the junction of the diaphragmatic and right border to the junction of the pulmonary conus and the left ventricle. The third measurement, the greatest horizontal depth of the heart (DD_h), is measured from the anterior edge of the contrast-filled esophagus to the anterior outline of the heart. Divergence of the rays is corrected by an enlargement factor. The volume (H_v) is calculated from the formula $H_v = k \times LD \times BD \times DD_h$. A nomogram is devised and presented to simplify calculations. The error of the method was determined in thirty-two cases and found to be 2.73%.

Correlation between heart volume and various body measurements was studied by a regression equation. Weight and body surface gave a fair correlation with heart volume.

The author proposes a new factor, "capacitance sur-

face," for correlation with heart volume and mentions blood volume as a possible factor also showing a good correlation.

This represents a diligently constructed work on a statistical basis. It serves as an interesting review of the various technics of cardiac mensuration. The bibliography is quite extensive.

Twenty-four figures; 11 tables; 2 nomograms.

JOHN F. RIESSER, M.D.
The Henry Ford Hospital

Auricular Calcification. George Miller, Irvin M. Becker, and Henry K. Taylor. Am. Heart J. **40:** 293–300, August 1950.

The authors report 8 cases in which auricular calcification was demonstrated roentgenographically, with postmortem verification in 5. The calcium was deposited in the endocardium. Associated calcific deposits were present in the mitral annulus in 1, and in the mitral and aortic cusps in 2. All of the patients had long-standing rheumatic heart disease; the mitral valve was involved in all, the aortic in 5, and the tricuspid in 4.

Auricular calcification is an infrequent finding. It may be associated with an endocrine or vitamin D disturbance. Calcium may be deposited in dead or devitalized tissue. In the absence of any of these changes, auricular calcification is usually secondary to a rheumatic auriculitis.

The calcification is demonstrable as a thin, curvilinear density within the area of the left auricle.

Four roentgenograms; 1 table.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Congenital Aortic Septal Defect. Daniel F. Downing. Am. Heart J. **40:** 285–292, August 1950.

The author gives the case history of a 9-year-old child with a congenital aortic septal defect. Thoracic aortography demonstrated a shunt from the aorta to the pulmonary circuit. It was not certain whether this was due to a patent ductus arteriosus or to an aortic septal defect, and exploration of the chest was undertaken. The child died on the operating table. When the great vessels were opened postmortem, a defect was seen in the aortic septum 10 mm. above the margins of the pulmonic valves.

Such a defect is due to incomplete division of the truncoconal channel by the truncoconal septum. Fourteen cases appear in the literature, including the one just cited. Four cases, not in the literature, were reported to the author by W. J. Potts (personal communication), and Dexter demonstrated a similar defect during cardiac catheterization (Modern Medicine, Feb. 15, 1949, pp. 92–96).

The ages of the 14 patients with proved aortic septal defect ranged from three days to thirty-seven years. Two died in the first week of life, 7 during the first year, 3 between one to nine years of age, 2 in the second decade, and 2 in the fourth. The symptomatology and physical findings presented no characteristic picture. Postmortem examination showed right ventricular hypertrophy in 10; in 4 the left ventricle was also hypertrophied. Associated cardiac defects were found in 6 instances: perforation of pulmonary valves, patency of the ductus arteriosus, patency of the foramen ovale, bicuspid aortic valve with an interventricular septal defect, and a right pulmonary artery arising from the aorta. The ascending aorta was enlarged in 2 cases, and contracted at the arch in 1. The pulmonary artery was larger than normal at the base in 1 case.

The communication between the aorta and the pulmonary artery varied from 2 to 16 mm. in diameter and was situated usually in the first few centimeters above the valves, but occurred at the level of the pulmonic valve in one instance and midway between the valves and the innominate artery in another.

Roentgenographically, the author's case showed an enlarged heart, dilatation of the pulmonary artery and pulmonary vessels, and a hilar dance.

Two roentgenograms; 1 photograph; 1 electrocardiogram.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Rheumatic Heart Disease in Service Pensioners. A Review of 318 Cases. Ronald Hartley. Brit. M. J. **2:** 396–398, Aug. 12, 1950.

Three hundred and eighteen patients drawing disability pensions for rheumatic heart disease discovered in the course of military service in the Armed Forces (Great Britain) are reviewed. Recurrent rheumatic fever, dyspnea on exertion, and routine examination led to the discovery of 87 per cent of the number. Inadequate clinical cardiac examination and lack of routine x-ray facilities at the time of induction were the chief reasons accounting for the acceptance of these men for service. Twelve of them had originally been rejected as volunteers but were subsequently drafted.

At the time of the diagnosis, full-size roentgenograms (usually postero-anterior only) were taken of 264 of the 318 patients, and 81.4 per cent were reported as showing enlarged hearts.

This study confirmed previous reports that service life is bad for patients who have had rheumatic fever. In 34 per cent of the cases there occurred, during service, some incident of the rheumatic disease which might be expected to affect permanently its natural history. Such incidents are the recurrence of rheumatic fever, auricular fibrillation, bacterial endocarditis, heart failure, angina of effort, and embolic phenomena. In all these cases, although such complications might have occurred in civilian life, the prognosis was made worse.

In the patients whose initial symptoms appeared after induction (29 per cent of the total), the presenting complaint could not be associated with military service, as the patients were of an age at which onset of symptoms is to be expected. The remaining patients appear actually to have benefited by service life. Symptoms in this group appeared only after the diagnosis was made on routine examination and are attributed to over-restriction of activity and inadequate knowledge, on the part of the men, of their own condition.

Three tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Cardiac Aneurysm Demonstrated by Angiocardiography. Erwin Kammerling, John B. Cavenagh, and Leon Unger. Illinois M. J. **98:** 129–132, August 1950.

A case is reported in which a large aneurysm of the left ventricle was well demonstrated by angiocardiography. Associated cardiac abnormalities were (1)

myocardial infarction, though the patient was only twenty-seven years of age with no elevation of blood pressure or evidence of diabetes, and (2) recurrent paroxysmal ventricular tachycardia. On the patient's first admission, at the age of twenty-five, a roentgenogram had shown a normal heart and lungs. Two years later roentgen studies showed a mediastinal mass but only upon angiocardiography was the diagnosis of cardiac aneurysm established.

Two roentgenograms; 4 electrocardiograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Pericardial Effusion Mistaken for Cardiac Enlargement in Severe Anemia. Report of Two Cases. Louis A. Soloff and C. T. Bello. Circulation **2:** 298–303, August 1950.

Anemia is sometimes the sole cause of enlargement of the so-called cardiac silhouette. With successful treatment of the anemia, the silhouette may be restored to normal. The enlargement has been attributed to cardiac dilatation.

Because of the recognized difficulty in distinguishing pericardial effusion from cardiac dilatation, direct puncture was attempted in two instances of anemia with the silhouette enlarged, presumably due to dilatation. In each instance, the enlargement was demonstrated to be attributable almost exclusively to pericardial effusion. One of the patients was a Greek girl of 19 years, with erythroblastic anemia of Cooley. The other was a 74-year-old woman with pernicious anemia.

The authors comment on the fact that neither the clinical nor the roentgen findings, as determined by ordinary technic, can help at all times in distinguishing cardiac dilatation from pericardial effusion. The electrocardiographic findings are obviously not crucial. The authors add that visualization of the cardiac chambers by diodrast may furnish the answer to this problem in differential diagnosis.

Four roentgenograms; 1 photomicrograph.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Ventricular Tachycardia During Cardiac Catheterization of Patient with Wolff-Parkinson-White Syndrome. Report of a Case Showing Effects of Atropine Sulfate. Robert A. Bruce, Paul N. G. Yu, Frank W. Lovejoy, Jr., Marion E. McDowell, and Raymond Pearson. Circulation **2:** 245–249, August 1950.

Cardiac catheterization of a patient with probable Wolff-Parkinson-White syndrome (abnormally short P-R interval, usually prolonged duration of QRS complexes, and repeated episodes of paroxysmal tachycardia) was attempted to clarify the possibility of coexistent congenital heart disease. Introduction of the catheter into the heart induced a multifocal ventricular tachycardia which endangered the life of the patient. After quinidine and other drugs had failed to control the arrhythmia that persisted for nine hours, a prompt and gratifying conversion to supraventricular tachycardia, and subsequently to sinus rhythm, followed the intravenous administration of atropine sulfate.

Four electrocardiograms. DANIEL WILNER, M.D.
Atlantic City, N. J.

The Electrokymograph: Studies in Recording Fidelity. Harry F. Zinsser, Jr., Calvin F. Kay, and J. Malvern Benjamin, Jr. Circulation **2:** 197–204, August 1950.

The electrokymograph was employed to record border movements and changes in roentgen opacity of the heart and great vessels. Ideally, the recorded movements should be simultaneous with and directly proportional in magnitude to the dynamic events being investigated. With this in mind, studies were made of the recording fidelity of several electrokymographs. Deviations from the ideal were of three types: (*a*) The sensitivity of the receptor slot of the phototube was not uniform. (*b*) A time lag, varying in these instruments from .015 to .025 second, between the event and the recording of the event, was observed. This was almost entirely a function of the filter. (*c*) The recorded amplitude of a movement of standard magnitude diminished with increasing rapidity of the movement. This was also a function of the filter.

It is apparent that for many of the problems to which the electrokymograph has been and will be applied, an exact measure of the recording characteristics of the specific instrument employed is essential to the accurate interpretation of the results.

Eight illustrations. DANIEL WILNER, M.D.
Atlantic City, N. J.

Electrokymographic Studies of the Normal Cardiac Cycle. Henry Mednick, John B. Schwedel, and Philip Samet. Circulation **2:** 250–257, August 1950.

Electrokymographic studies were made of the cardiac cycle in 53 persons. In 29 of the group a single electrokymogram was obtained; in the remainder two electrokymograms were made simultaneously.

By comparing the sequence of events in the carotid pulse, auricle, and ventricle, measurements were made of the phases of the cardiac cycle. The data obtained may be interpreted as follows: The right auricle contracts about .02 second before the left. After an isometric contraction phase of .04 second the semilunar valves open, with the pulmonary valve about .01 second ahead of the aortic valve. (This may vary from .03 second before to .02 second after.) The systolic ejection phase follows, its duration varying with the pulse rate. After an isometric relaxation phase of .116 second for the left ventricle (varies from .07 to .14 second) the mitral valve opens, with the tricuspid valve opening .025 second ahead of it.

Simultaneous electrokymography of the right- and left-sided chambers and vessels of the heart was found to provide a simple method for comparing synchronicity of events in normal and pathologic states.

Three electrokymograms; 1 diagram; 1 table.

DANIEL WILNER, M.D.
Atlantic City, N. J.

THE DIGESTIVE SYSTEM

Perforation of the Esophagus. An Analysis of 50 Cases and an Account of Experimental Studies. William D. Seybold, Marcellus A. Johnson, III, and William V. Leary. S. Clin. North America **30:** 1155–1183, August 1950.

The authors have presented an excellent review of the entire subject of perforation of the esophagus based

on 50 cases seen at the Mayo Clinic during the period 1907 to 1949.

The perforation is most commonly due to instrumentation with the esophagoscope or dilating bougie. The mechanism is usually one of three types: (1) immediate perforation through the entire wall, (2) tearing of the mucous membrane followed by suppuration, breaking through the other layers, (3) necrosis due to pressure of a retained and impacted foreign body. The most common sites of perforation are at the areas of physiological narrowing, namely, the level of the cricoid cartilage (54 per cent), level of the aortic arch (10 per cent), and at the point of passage through the diaphragm (36 per cent). The retrovisceral and pretracheal spaces are the most common pathways of spread of infection from esophageal perforation and their anatomy is discussed in detail.

In 16 of 20 cases of perforation of the lower esophagus, empyema developed: in 10 on the left, in 5 on the right, and in one instance bilateral. Mediastinitis was more commonly secondary to empyema, although the opposite did occur.

Symptoms are listed in the order of frequency as follows: pain, fever, dysphagia, respiratory distress, hoarseness, and cyanosis. A history of trauma from instrumentation or foreign body is extremely important for the diagnosis. Physical signs are dependent upon the complicating mediastinitis or pleuritis. They are tenderness, crepitation, splinting of local muscles, dyspnea, and occasional cyanosis.

Roentgenographically, anteroposterior and lateral views of the neck and thorax are usually sufficient. The authors believe that an esophagram with barium or iodized oil, as advocated by some, is not necessary and very often does not show the perforation. Roentgen signs of perforation of the upper esophagus are: gas in the tissues, widening of the superior mediastinum, and anterior displacement of the trachea. Signs of lower esophageal perforation are mediastinal widening, emphysema, pleural effusion, and intrapulmonary lesions.

Early surgical intervention is extremely important and consists chiefly in local drainage in contrast to closure in perforations of stomach and small bowel. Illustrations of a classical cervical mediastinotomy and a posterior inferior mediastinotomy, with a detailed discussion, are included under treatment.

Of 24 patients with mediastinitis alone, 5 (20.8 per cent) died; of 9 patients with mediastinitis and empyema, 6 (66.7 per cent) died; of 6 patients with only empyema, 1 (16.7 per cent) died.

Fifteen illustrations, including 6 roentgenograms; 2 tables.

E. KASH ROSE, M.D.
University of Louisville

On the Diagnosis of Atresia of the Esophagus. Report of a Case. Sigurd Eck, Leif Efskind, and Aage Wolff. Acta radiol. **33:** 529–534, June 1950.

The diagnosis of atresia of the esophagus has assumed greater importance since the first successful operation for its correction in 1939. The condition has been classified, on the basis of the various types of abnormality, by Vogt (Am. J. Roentgenol. **22:** 463, 1929) and O'Bannon (Radiology **47:** 471, 1946). The use of iodized oil and the observation of air within a segment of the esophagus when there is connection with the trachea are the methods commonly utilized in its detection. A catheter may be inserted into the upper blind pouch and the pouch expanded with air.

The authors report the case of a 3-day-old boy with the usual clinical symptoms of esophageal atresia. Roentgenograms showed the characteristic blind pouch in the upper part of the mediastinum, with compression and anterior displacement of the trachea. Both air and the contrast medium were seen in the stomach and small bowel. None was visualized in the trachea or bronchi. Films made without contrast medium showed a narrow, air-filled passage between the trachea and the stomach, and the case was diagnosed as Vogt's Type IIIB [with fistula between the lower segment and the trachea]. This is the most common type and constitutes 80 to 90 per cent of all cases. Upon operation, the diagnosis was confirmed, and the distance between the two esophageal segments was found to be about 4 cm. A primary anastomosis was made, but as a result of tension the suture line broke down, with formation of an esophageal fistula, on the eleventh day. A gastrostomy was performed and maintained for four weeks to permit healing of the fistula. A residual narrowing of the esophagus at the site of anastomosis was easily controlled with dilatation.

From the radiographic findings alone, this case might have been one of O'Bannon's Type IV, namely, a partial stricture of the esophagus without connection with the trachea or other air passages. The presence of contrast medium in the stomach but not in the trachea or bronchi strongly suggested such a condition. Actually there must have been aspiration of the medium and passage from the trachea, through the fistulous opening, into the stomach.

Four roentgenograms; 2 drawings.

G. REGNIER, M.D.
University of Arkansas

Clinical-Roentgenological Studies of Gastric Dilatation. Heinrich Berning. Fortschr. a. d. Geb. d. Röntgenstrahlen **73:** 165–175, June 1950. (In German)

Gastric dilatation is classified etiologically as follows:

1. Primary organic conditions of the upper gastrointestinal tract or surrounding region with secondary dilatation of the stomach.
   (*a*) Duodenal or pyloric ulcer with stenosis.
   (*b*) Carcinoma of pylorus or prepyloric region (less often of the duodenum, intestine, or head of the pancreas).
   (*c*) Scar contraction, with formation of folds in the duodenum or intestine.
   (*d*) Marked inflammatory mucosal swelling.
   (*e*) Pyloric hypertrophy.
   (*f*) Arterial mesenteric compression (?).
   (*g*) Less frequent causes: submucosal hemorrhage in the duodenum, compression from tumor or aneurysm, volvulus of stomach, diaphragmatic or retroperitoneal hernia, etc.
2. Functional atony and dilatation of the stomach without a mechanical factor.
   (*a*) Metabolic disturbance with ketonemia (diabetic coma, postoperative, azotemic vomiting, infections, etc.).
   (*b*) Intra-abdominal inflammatory conditions.
   (*c*) Intra-abdominal operations.
   (*d*) Abdominal trauma.

The cases analyzed in this study showed gastric dilatation with no mechanical obstruction. The study was at first limited to patients with diabetic coma or those with acidosis. It was found that the degree of dilatation of the stomach was roughly parallel to the severity of the acidosis. The dilatation may be extreme and occur very rapidly. After correction of the underlying condition in most cases, the size of the stomach returned to normal.

The other conditions in the second classification were considered from the author's experience and on the basis of the literature. Although many conditions may be responsible for the loss of gastric tone, with marked dilatation, the disturbance of metabolism underlying such conditions seems to be similar. The paralyzing effect of ketone bodies in the blood is present in all cases. Treatment consists in recognizing the condition and active treatment of the acidosis.

Eight roentgenograms; 1 photograph.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Benign Ulcer of the Greater Curvature of the Stomach. Report of a Case. Sidney M. Fierst, Howard L. Jones, and S. Charles Franco. Gastroenterology **15:** 750–753, August 1950.

Benign ulcer of the greater curvature is extremely rare. During a ten-year period at Massachusetts General Hospital, all greater curvature ulcers reviewed by Allen and Welch proved to be malignant (Ann. Surg. **114:** 498, 1941).

The authors present the case of a 32-year-old man who was admitted with massive hematemesis. A gastro-intestinal series showed a 3.0-cm. ulcer on the inferior portion of the greater curvature. The patient refused surgery and improved on medical therapy for a short time, but subsequently symptoms returned. Roentgen examination and gastroscopy showed persistence of the ulcer and a subtotal resection was performed. The pathological diagnosis was chronic ulcerative gastritis.

One roentgenogram; 1 photomicrograph.

NELSON E. KLAMM, M.D.
Cleveland City Hospital

Large Partially Calcified Gastric Leiomyoma. Eugene L. Koloski, Paul L. Shallenberger, and George W. Hawk. Am. J. Surg. **80:** 245–248, August 1950.

In three large series of neoplasms of the stomach reported from autopsy material, benign tumors were found to constitute approximately 22 to 26 per cent of the total cases. These figures are considerably higher than those reported in two large series of gastric neoplasms encountered at operation, in which the benign group constituted only 1.3 per cent of the total cases. Most of the patients with benign gastric tumor who have been hospitalized for study give a long-standing history of mild gastric distress and many of them present evidence of either hemorrhage into the gastro-intestinal tract or pyloric obstruction. Ulceration within benign gastric tumors has been frequently observed; the authors, however, did not find any report of calcification within a benign gastric neoplasm. They present such a case.

The patient was a 67-year-old woman whose chief complaint was hematemesis. A smooth, movable mass was palpable in the epigastrium. Roentgenographic examinations revealed a large, partially calcified, tumor on the lesser curvature, ulcerated in its central portion. At operation the mass measured 15 × 10 × 7.5 cm., and the ulcer in the central portion of the mucosal surface 3.5 cm. in greatest diameter. The pathologic diagnosis was leiomyoma of the stomach with ulceration and calcification.

Six illustrations, including 3 roentgenograms.

HENRY C. BLOUNT, JR., M.D.
University of Pennsylvania

Bezoars of the Stomach. Roderick L. Tondreau and B. R. Kirklin. S. Clin. North America **30:** 1097–1108, August 1950.

"Bezoar" is a term applied to masses of various materials found in the alimentary tract of both men and animals. Bezoars are classified according to the type of predominating material composing them (1) trichobezoars (hairballs, haircasts, pilobezoars), (2) trichophytobezoars, (3) phytobezoars (hortobezoars), and (4) concretions. The number of recorded cases to date is about 400. Trichobezoars are the most common, though there has been an increasing percentage of phytobezoars reported in the past thirty years, especially persimmon bezoars.

At the Mayo Clinic, from which this report comes, a total of 23 patients have been found to have bezoars. Six had hairballs; 13 had persimmon bezoars; in 3 instances the character of the bezoar was not recorded, and in 1 patient the stomach contained multiple masses of paraffin. The history of this last case is given.

The responsibility for the diagnosis of bezoars rests with the roentgenologist. At fluoroscopy, with a barium suspension, the appearance is usually distinctive. The barium fills the space between the mass and the stomach wall, and depicts a grossly normal gastric outline with a central radiolucent area which corresponds to a mass that is often movable. If multiple bezoars are present, the barium fills the interspaces, demonstrating the individual masses. Hairballs usually show a finely reticulated structure. The radiolucent areas representing a persimmon bezoar may be mottled, with local densities that are coarser than those observed in the presence of trichobezoars.

Gastroduodenal ulcerations and intestinal obstruction are the most common complications.

Four roentgenograms; 4 photographs.

EDSEL S. REED, M.D.
University of Louisville

Trichobezoar in a Four-Year-Old Child. Kenneth C. Sawyer, William R. Coppinger, and John M. Nelson. J. Pediat. **37:** 393–395, September 1950.

A search of the literature revealed only 5 cases of trichobezoar in children five years of age or younger. The authors report a case in a girl of four and a half years, diagnosed preoperatively.

One roentgenogram; 1 photograph.

Primary Adenocarcinoma of the Third Portion of the Duodenum. Julius E. Stolfi and James C. Barnett. Gastroenterology **15:** 780–785, August 1950.

This case is presented by the authors because of the rarity of primary carcinoma of the third portion of the duodenum. According to the literature, the incidence is placed at 0.033 and 0.040 per cent. Three points

of interest are mentioned: (1) the lesion is often missed because it is frequently behind the bulk of the stomach; (2) the initial x-ray films may simulate the picture of obstruction either by the superior mesenteric artery or by disease in the uncinate portion of the pancreas; (3) metastasis occurs at a later date.

The authors' patient, a man of 64, had a four-week history of epigastric distress, nausea, and copious vomiting of bile-stained material. He had lost fourteen pounds and complained of constipation and some bloating after meals. The fluoroscopic and radiographic examination revealed a moderate distention of the second portion of the duodenum, and in the mid-portion of the third part, at the crossing of the superior mesenteric artery, definite obstruction. The proximal duodenum filled with barium and retroperistaltic waves were then observed, causing regurgitation back into the stomach, accompanied by nausea. The five-hour films showed a definite intrinsic lesion involving the mucosa of the distal third and complete fourth part of the duodenum in the region of the ligament of Treitz. Presumably, this finding was due to neoplastic involvement with deformity.

At operation, a hard nodular tumor about the size of a lemon could be felt in the duodenum just proximal to the ligament of Treitz. It was resected and found to involve the second and third portions of the duodenum, extending to the fourth part. The patient never regained consciousness and expired about fifteen hours after operation. The pathologic diagnosis was cylindrical-cell adenocarcinoma of the duodenum with mucoid degeneration.

Two roentgenograms; 1 photograph; 1 photomicrograph.

HARRY HAUSER, M.D.
Cleveland City Hospital

High Gastrointestinal Obstruction in the Newborn Infant: A Radiological Interpretation. Max Dannenberg, Charles Storch, S. David Sternberg, and Charles Hoffman. J. Pediat. **37:** 380–386, September 1950.

It is the purpose of this paper to demonstrate the roentgen findings in high gastro-intestinal obstruction in the newborn, and to emphasize the need for the earlier and more frequent use of the plain film of the abdomen as a screening procedure in newborn infants with persistent vomiting.

In obstruction of the duodenum or proximal portion of the jejunum, a film of the abdomen in the upright position reveals a large, distended, air-containing stomach. Occasionally the first portion of the duodenum is also distended. The presence of a fluid level depends on the amount of feedings previously given and the amount of vomiting. The remainder of the gut appears as an airless homogeneous haze. When obstruction is incomplete, as in a stenosis or the presence of a congenital band, a few bubbles of air may be seen in the region of the duodenum or upper jejunum, with a greatly dilated duodenum and stomach above and an airless haze below. The diagnosis of high intestinal obstruction can be made and preparations for operation instituted without delay. Contrast media are not necessary to establish the diagnosis and may, in fact, be dangerous, since they may result in plugging of the intestinal tract, making operation more difficult, or in vomiting or aspiration. Additional information may be obtained by taking a plain film in the prone position. In this view, air may be visualized in the duodenum or proximal jejunum, which was obscured by fluid in the erect position. It is also advisable to take films after decompression of the upper intestinal tract in order to determine the point beyond which air does not pass.

Symptoms of high intestinal obstruction may be associated with normally appearing intestinal shadows in esophageal atresia with a tracheo-esophageal fistula below the esophageal obstruction. In this event, although vomiting occurs early because of the atresia, air may enter the stomach and intestines *via* the tracheo-esophageal communication.

Five illustrative cases are reported.

Eight roentgenograms.

Intussusception in Infants and Children. Analysis of 152 Cases with a Discussion of Reduction by Barium Enema. Mark M. Ravitch and Robert M. McCune, Jr. J. Pediat. **37:** 153–173, August 1950.

This article discusses intussusception in 151 children below the age of fifteen treated at the Johns Hopkins Hospital from 1889 to 1948. It goes into great detail regarding the incidence, the symptoms, the physical examination, the laboratory findings, and treatment.

The authors feel that the best treatment for intussusception is the radiologically controlled barium enema. This is used in all children, regardless of the duration of the intussusception. When intussusception is suspected, the operating room is advised to prepare for operation. The child is taken to the fluoroscopic room and a Foley bag catheter with 45-c.c. balloon is inserted into the rectum and the balloon distended. The catheter should be ungreased, and firm pressure should be maintained on the buttocks. The enema can is elevated to three feet above the table and the flow of barium watched fluoroscopically. When the barium reaches the intussusception, it forms a concave meniscus. As pressure increases, the meniscus lengthens, the horns extending until the intussusception is pushed back and the meniscus flattens out again. The process is continued until the intussusception is reduced to the cecum and through the ileocecal valve.

If the intussusception is not completely reduced after several minutes, the catheter is removed and the infant allowed to expel the barium. The process should not be repeated more than three times. After completion of the reduction, powdered charcoal is deposited in the patient's stomach through a tube, and six hours later an enema is given to recover the charcoal to prove the completeness of the reduction.

Since 1939, 48 cases have been treated by barium enema: 33 were reduced by enema alone, 15 had a subsequent operation to complete the reduction. There were no deaths. The authors feel that the procedure of reduction should be undertaken by the surgeon whose responsibility it is to decide whether open operation is to be performed. Successful reduction is indicated by the following criteria: (1) the entrance of the barium well into the small bowel, (2) return of the barium with feces or flatus, (3) disappearance of the mass, (4) clinical improvement of the child, who often falls into a natural sleep, and (5) subsequent recovery in the stool of charcoal given by mouth, or the appearance of a blood-free stool.

Four roentgenograms; 2 drawings; 6 charts; 2 tables.

PAUL W. ROMAN, M.D.
Baltimore, Md.

Surgical Management of the Complications of Diverticulitis of the Large Intestine. Analysis of 202 Cases. Charles W. Mayo and Charles P. Blunt. S. Clin. North America **30:** 1005–1012, August 1950.

The authors report an analysis of 202 cases of complicated diverticulitis observed over a ten-year period, in all of which the diagnosis was confirmed pathologically.

The complications of diverticulitis which demand surgical intervention are fistula, abscess, and obstruction; in some cases operation may be necessary to differentiate between a malignant lesion and an obstructing diverticulitis.

Barium enema studies offer the most reliable and accurate means of determining the nature of the lesion. In the barium-filled colon, diverticulitis is manifested by a constricted segment of bowel which is relatively long; the constriction begins and ends gradually and there is usually no ulceration of the mucous membrane. In carcinoma, on the other hand, the segment of constricted bowel is short, the constriction begins and ends abruptly, and the mucosa is nearly always ulcerated. When obstruction is complete, it is impossible to determine the nature of the lesion. Preoperative roentgen studies were done in 174 of the authors' series and in 81 per cent were definitely suggestive of diverticulitis or diverticulosis.

The mortality rate for the 202 cases was 3.5 per cent. More adequate preoperative preparation, including sulfasuxidine, is thought to account for the low mortality compared with other groups of cases.

Two tables. EDSEL S. REED, M.D.
University of Louisville

Acute Diverticulitis of the Large Bowel. L. S. Fallis and M. R. Marshall. Am. J. Surg. **80:** 198–203, August 1950.

Ninety-four cases of acute diverticulitis seen at Henry Ford Hospital in Detroit are analyzed. Eighty per cent of the patients were in their fifth, sixth, and seventh decades, with half of this number in the fifty-to-sixty-year age group. The ratio of males to females was approximately 2:1. Over one-third of the patients had experienced previous similar episodes, and 21.2 per cent had previous x-ray evidence of diverticulosis. Fifty-eight per cent gave a history of constipation or "chronic irritable colon," and 14 per cent admitted taking cathartics regularly.

The common complaints on admission were pain, fever ranging from 99 to 105.6° F., and bloating. The pain was usually in the left lower quadrant, since the sigmoid colon is the commonest site of diverticulitis, but distention of the cecum or the presence on the right side of long movable sigmoid loops caused localization on the right in 8 cases, leading to an erroneous preoperative diagnosis of acute appendicitis in 5 instances. Muscle spasm and tenderness were likewise most common on the left, but occasionally present on the right.

Occult blood was present in the stools in 41.3 per cent of the cases; the red blood count averaged 4,440,000 and the white blood count 14,600, with a considerable range. Patients with the complications of abscess formation or spreading peritonitis tended to have the highest temperatures (above 102° F.), highest white blood counts, and most severe distention.

A radiologic confirmation of the diagnosis was usually deferred until the acute phase of the disease had subsided, although it is now felt that this was perhaps an over-cautious practice. The chief value of x-ray examination is to differentiate diverticulitis from carcinoma or discover a possible coexisting carcinoma, and to detect abscess or internal fistula formation. Some differential points are as follows: (1) Obstruction is more common with carcinoma. (2) Destruction of the mucosa suggests carcinoma, while heaping up of the mucosa is more indicative of diverticulitis. (3) Ballooning of the rectum is often present in carcinoma; spasm is more frequently a sign of diverticulitis. The use of tetraethylammonium chloride prior to examination was found to aid in the demonstration of diverticula by reducing spasm and thus relaxing their mouths and allowing the entrance of barium. Sigmoidoscopy should be carried out after subsidence of the acute phase to help rule out carcinoma.

Treatment is primarily medical. Surgical intervention is indicated only in the case of complications, the most important of which are perforation and obstruction. The procedure of choice is a temporary transverse colostomy, plus peritoneal drainage in the case of abscess formation or generalized peritonitis. The over-all mortality of medically and surgically treated cases in this series was 7.2 per cent.

Three roentgenograms.

WILLIAM C. OWSLEY, JR., M.D.
University of Pennsylvania

Amebic Abscess of the Liver. Edgar E. Struve. California Med. **73:** 178–180, August 1950.

In 50 cases of amebic abscess of the liver seen in the Canal Zone between 1920 and 1945, the incidence was highest between the ages of twenty and forty, with no patient under twenty-one. The disease occurred only in persons who had spent several years in a locality where there was a high incidence of amebiasis. Eight of the 50 cases were diagnosed clinically but not proved by aspiration and are therefore excluded from the present study. The most common symptoms were pain in the right upper quadrant, generalized abdominal pain, pressure pain in the right chest, fever, bloody diarrhea, and pain in the shoulders and back. Physical findings were most commonly tenderness and rigidity in the right upper quadrant, and evidence of liver enlargement. Single finger percussion over the liver area with aspiration at point of maximum tenderness was most helpful diagnostically.

Roentgenography and fluoroscopy of the chest, to show signs of elevation and/or fixation of the diaphragm, was often of aid in the diagnosis. In 11 cases this finding was present and was considered diagnostic of a subdiaphragmatic lesion. Other laboratory studies, aside from demonstration of amebae in the stools (present in only one quarter of the cases) and evidence of anemia and leukocytosis, were not helpful.

Treatment was by emetine hydrochloride and operative drainage of the abscess. Six of 39 cases in which drainage was done terminated fatally. In 5 of the 6, multiple abscesses were found, some of which were missed at operation. There was only one death in patients with a single abscess.

Two additional cases seen in Peru are described in detail. BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Gallstone Ileus. Virgil Ray Forester. Gastroenterology **15:** 679–683, August 1950.

The symptoms of intestinal obstruction due to gallstones are less well defined than those of ileus of any other origin. The more typical cases are characterized by the onset of intestinal obstruction in a patient with a previous history of biliary colic. In most cases there is a prodromal period of vague abdominal disturbance, nausea, and in some cases vomiting. There may be a long and intermittent history of gastric distress and epigastric pain. The onset of partial or complete obstruction is frequently preceded by shifting cramp-like pain, moderate distention, and a flaccid abdomen, which seem to indicate that a ball-valve type of obstruction is present early, gradually producing sufficient irritation to cause edema and retention of the calculus in place.

Among 1,167 patients who received a diagnosis of intestinal obstruction at Kings County Hospital (Brooklyn, N. Y.) over a period of ten years, there were only 7 cases of gallstone ileus. The radiographic examination contributed little to the diagnosis. In only one instance was the obstructing mass outlined, but even then a positive diagnosis was not possible. An early correct diagnosis is seldom made.

Perforation usually occurs from the fundus of the gallbladder. The exact time is seldom determined, since the actual perforation is a prolonged procedure preceded by a localized chronic peritonitis about a diseased gallbladder which becomes adherent to adjacent bowel into which the stone slowly ulcerates. If the stone is large, the most common site of impaction is at the ligament of Treitz. The next most common site is at the ileocecal valve.

Seven cases of gallstone ileus are presented in this report. All patients were females and the average age was 67 years.

JACK WIDRICH, M.D.
Cleveland City Hospital

Carcinoma of the Gallbladder. Alex W. Ulin, Irving L. Lichtenstein, Anthony Garritano, and Seth M. Fischer. Gastroenterology **15:** 684–688, August 1950.

When a preoperative diagnosis of biliary carcinoma is possible by present-day studies, it is beyond surgical resection or palliation. In an attempt to develop diagnostic criteria which would indicate early malignant disease of the gallbladder and to establish a relationship, if any, between gallstones and carcinoma, the authors reviewed 500 unselected cases operated on for gallbladder disease over a period of recent years.

Fourteen cases of proved biliary carcinoma were encountered in the series. This represents an incidence of 2.8 per cent. As the authors put it, "one of every thirty-six operative gallbladders revealed definite evidence of cancer of the organ." In only one case was cancer suspected, and in this case the preoperative diagnosis was "intra-abdominal malignancy." The average age of the 500 patients was fifty years, while the average age of the 14 patients with carcinoma was sixty-one years.

An attempt was made to determine any relationship between calculous cholecystitis and biliary carcinoma. Seventy-five per cent of the patients who had primary carcinoma of the gallbladder were found to have gallstones. In the present series, in 350 cases of gallbladder stones there were 10 instances of cancer, an incidence of 2.9 per cent. The question of whether cholecystectomy is justified in the presence of cholelithiasis, whether silent or symptomatic, as a prophylactic measure against cancer was raised, but the authors could not come to a definite conclusion on this point from the cases studied.

The common findings in carcinoma of the gallbladder, pain and dyspepsia, followed by weight loss, jaundice, and a palpable mass, appear only when the case is incurable. Suggested criteria for an earlier diagnosis are based on the fact that 50 per cent of the cancer patients were between the ages of sixty and seventy. Ten per cent of all operative gallbladder cases in the seventh decade revealed evidence of cancer.

This study indicates that a high index of suspicion and a careful evaluation of gallbladder patients will result in finding earlier stages of carcinoma of this organ. The authors consider the following syndrome suggestive of cancer of the gallbladder: cholelithiasis in a patient in the sixth decade or older, and any history of dyspepsia. The first indications of weight loss, anemia, icterus, and change in status of well being should be judged gravely in any patient with cholelithiasis.

JACK WIDRICH, M.D.
Cleveland City Hospital

Further Observations on the Clinical Value of Cholangiography. Dean Macdonald. Am. J. Surg. **80:** 349–355, September 1950.

The author presents six groups of cholangiograms and discusses briefly their clinical significance. By means of cholangiography, one can visualize the biliary ductal system and careful interpretation of such studies will increase the incidence of correct diagnosis and therapy.

The first group of roentgenograms shows the normal biliary ductal system and common variants. The second group consists of postoperative cholangiograms in cases of acute cholecystitis; the third is from a case of duct obstruction due to a mucous plug; the fourth illustrates the value of routine duct intubation at cholecystectomy; and the fifth the necessity of serial studies for the correct reading of calculus-like shadows. The remaining group includes a number of cases of more than average clinical interest, including one of nodular diffuse pancreatitis and one of carcinoma of the common hepatic duct.

The technic of the examination is discussed. Several exposures in proper positions are important for correct interpretation. The author believes that delayed, or postoperative, cholangiography is more practical and accurate than immediate or operative studies.

Twenty-six cholangiograms.

SHIH-CHANG HWANG, M.D.
University of Pennsylvania

THE ADRENALS

Adrenal Neuroblastoma. R. Wallace Boyd. Canad. M. A. J. **63:** 153–157, August 1950.

Six cases of adrenal neuroblastoma seen at the Vancouver General Hospital (British Columbia) from 1945 to 1948 are discussed. There was only one male in the series, although there has been no significant difference in sex incidence of these tumors reported in the literature. The age range in this series was fourteen months to five years.

Symptoms common to all cases were non-specific

manifestations of anemia, fever, and toxemia. In only one case had an abnormal mass in the abdomen been noticed by the parents; however, all presented a large palpable right or left upper abdominal mass at or soon after admission to the hospital.

Roentgen studies proved to be of value in localizing the tumor in relation to the intra-abdominal structures, and for skeletal survey for metastases. Barium enema, barium meal, intravenous urography, and plain film studies of the chest, abdomen, and skeleton were employed. Findings of significance included abnormal calcification in the region of the tumor, displacement of kidney, ureter, and gastro-intestinal tract, and a characteristic moth-eaten osteoporosis in metastatic bone lesions.

Roentgen therapy was undertaken in 5 of the 6 cases. The primary tumor and the skull metastases were irradiated. One patient received total body irradiation. There was rapid regression of the primary lesion in 3 cases with left-sided tumor, but the metastases showed no response in all cases. The 2 tumors which showed no response were both on the right side, and both tolerated treatment poorly. None of the patients lived longer than eight months from the onset of symptoms.

Six roentgenograms; 3 tables.

HARVEY J. THOMPSON, JR., M.D.
Jefferson Medical College

HERNIA

Hiatus Hernia. Analysis of Twenty-Five Cases. Eugene E. Simmons, Robert S. Long, Howard B. Hunt, and Ralph C. Moore. Arch. Int. Med. **86:** 253–265, August 1950.

As defined in this report, a hiatus hernia is a sliding herniation of the stomach through the esophageal hiatus. These hernias are more common in obese subjects, in middle age, and in females. Contributory causes are increased intra-abdominal pressure and weakness or maldevelopment of the diaphragm.

The symptoms of epigastric pain or fullness, usually worse after eating or reclining, are the most common, but hematemesis, melena, and anemia also occur. The distress may appear at night and may be relieved by getting up. Regurgitation not associated with nausea often follows the distress. Epigastric tenderness was present on palpation in about half of the patients in this series and a fourth of them had epigastric muscle guarding.

The x-ray diagnosis of hiatus hernia is based on locating the esophagogastric junction or a protrusion of the cardia above the diaphragm. Suggestive signs are a tortuosity without dilatation of the distal esophagus or a slowing of the barium stream at this same level. The examination is best done with the patient supine or in the Trendelenburg position with the right side rotated anteriorly 30 degrees. A transient dilatation of the distal esophagus preceding a peristaltic wave, the phrenic ampulla, is differentiated from hiatus hernia by its disappearance during fluoroscopy as the barium passes through the esophagogastric junction. The barium swallow also identifies those hernias which appear on chest films as a retrocardiac mass, a fluid level, or a mediastinal widening.

Six cases illustrating the variety of symptoms and findings in hiatus hernia are presented: one of an asymptomatic hernia, one simulating a coronary thrombosis, one associated with severe hematemesis and melena, one simulating pleural fluid, one with a sarcoma in the herniated portion of the stomach, and one occurring in the last trimester of pregnancy, with hematemesis and perhaps precipitated by coughing.

Hiatus hernia must be considered in the differential diagnosis of conditions occurring in the upper abdomen and chest. Other lesions such as peptic ulcer, gastric cancer, etc., may coexist and must be sought for before concluding that the hernia is fully or solely responsible for the clinical picture in any given case.

Five roentgenograms; 1 drawing.

CORNELIUS COLANGELO, M.D.
Chicago, Ill.

Diaphragmatic Hernia of the Spleen. Aristide Rollandi. Radiol. med. (Milan) **36:** 642–653, August 1950. (In Italian)

The author presents two cases of herniation of the spleen through the diaphragm and states that, although the spleen alone may herniate, usually it is accompanied by some of the hollow viscera. The diagnosis is based on the lack of the splenic shadow within the abdomen and the presence of a mass above the left diaphragm. The contraction of the spleen following the injection of adrenalin may help the diagnosis and the induction of an artificial pneumoperitoneum may determine the presence or absence of a hernial sac.

Six roentgenograms.

CESARE GIANTURCO, M.D.
Urbana, Ill.

THE MUSCULOSKELETAL SYSTEM

Multiple Myeloma. Lars Anda. Acta radiol. **33:** 515–528, June 1950.

The author presents the results of a study of 12 cases of multiple myeloma observed at the Norwegian Radium Hospital between 1938 and 1948, in which the diagnostic possibilities of roentgen examination and the radiosensitivity of the condition were investigated. Classification according to Aegerter and Robbins (Am. J. M. Sc. **213:** 282, 1947. Abst. in Radiology **50:** 132, 1948) was used: (1) a diffuse osteoporotic type without localized nodules, in which all the red marrow is believed to be affected simultaneously; (2) a classical type occurring as multiple tumors of the skeletal system, predominantly in flat bones and in the metaphyses of long bones; (3) a solitary type, including two sub-types, namely, a cystic trabecular type resembling benign giant-cell tumor of bone and an osteolytic type resembling metastatic cancer. In this series no diffuse osteoporotic lesions were encountered but 2 of the 4 classical types were borderline; 7 were solitary lesions with subsequent multiple involvement; 1 remained solitary.

A probable diagnosis of multiple myeloma roentgenographically appeared justified in a limited number of advanced cases of the classical type. In most cases other methods of examination must be considered, namely, blood changes (hyperproteinemia, hyperglobulinemia, hypercalcemia) and myelomatous changes in sternal marrow or biopsy specimens. Serum proteins were investigated in 5 cases, none of which revealed hyperproteinemia. All showed comparatively high globulin. The sedimentation rate was increased in most instances, but was depressed in 3 cases of solitary type. Blood calcium, determined in 2 cases, was not increased. Bence-Jones protein was sought in

10 cases and was found in 2. Of 10 sternal smear examinations, 1 revealed myeloma cells and 6 showed plasmocytes. In 10 cases, needle biopsy of a bone focus was done, leading in most instances to a diagnosis of plasmocytoma; in 2 cases the histologic diagnosis was tumor tissue composed of myeloma cells.

Diffuse osteoporotic myeloma may resemble other osteoporotic diseases, such as hyperparathyroidism, syphilis, and diffuse carcinomatosis. In the classical type, roentgenograms, though highly suggestive, may not be conclusive, as the findings may be consistent with cancer metastasis, osteolytic sarcoma, lymphoblastoma, or lymphogranulomatosis. Needle biopsy will differentiate solitary lesions from giant-cell tumor, solitary cystic or metastatic disease, and lipoid granuloma.

External radiation therapy was administered in all cases (175 kv., 4 ma., target-skin distance, 50 cm., filtration 1 mm. Cu). The plan of treatment most frequently used was 350 r daily to a total of 3,500 r. Five cases showed subjective improvement; objective improvement occurred in 3; in 4 there was no apparent improvement. In 1 case, total body irradiation of 600 r in twenty days was administered but produced no improvement. For the entire series, the average survival following treatment was twenty months.

The combined diffuse osteoporotic and the classical types showed subjective improvement in 2 cases and no improvement in 2; the average survival was six months. Two patients with solitary myeloma with subsequent spread were improved subjectively, 2 objectively, and 3 were unimproved. The average survival for this group was two years and eight months. One patient is still alive after eight years and seven months, and 1 with advanced disease expired following a few small doses. Although the author considers the series too small to allow definite conclusions, he believes it indicates that, of the various types, solitary myeloma is most radiosensitive, and occasionally radiocurable, although requiring vigorous irradiation. Caution in arriving at conclusions is in order because of the capricious and often prolonged course run by the solitary type.

It appears, further, that definite roentgenologic information is obtainable in certain far-advanced cases and in the classical types with multiple manifestations. The roentgen findings are often not characteristic and diagnosis becomes dependent upon biopsy and supporting biochemical examinations.

Ten roentgenograms; 2 photomicrographs; 2 tables.

HOWARD B. BURNSIDE, M.D.
University of Arkansas

Fibrocystic Disease of Bone. H. A. Thomas Fairbank. J. Bone & Joint Surg. **32-B:** 403–423, August 1950.

The outstanding contributions in helping us arrive at our present knowledge of skeletal lesions characterized chiefly by fibrosis were made by von Recklinghausen in 1891, Askanazy in 1904, Mandl in 1926, Hunter and Turnbull in 1931, Elmslie in 1933, and by Albright in 1934.

This paper presents a general discussion of fibrous dysplasia of bone. Under polyostotic fibrous dysplasia (synonyms: multiple diffuse fibrosis of bone, osteitis fibrosa disseminata), the author discusses the etiology, distribution of bone lesions, signs and symptoms, radiographic appearance, progress, complications, pathology, and differential diagnosis. Leontiasis ossea (synonym: hyperostosis of skull) is discussed separately. The author points out, however, that there is no reason for regarding leontiasis ossea occurring alone as different and distinct from the hyperostosis of the skull seen in many cases of polyostotic fibrous dysplasia. Leontiasis ossea should be regarded as a "clinical picture" rather than as a disease or clinical entity.

Five case histories of polyostotic fibrous dysplasia are presented with follow-up studies extending over several years. These include one case with unilateral distribution and without skull involvement and one case with limited unilateral involvement.

This paper is No. 17 in the author's Atlas of General Affections of the Skeleton, appearing currently in the *Journal of Bone & Joint Surgery* (British volume).

Thirty-eight roentgenograms; 3 photomicrographs; 1 photograph.

J. DUDLEY KING, M.D.
Crawford Long Hospital, Atlanta, Ga.

Two Cases of Osteochondritis Dissecans Affecting Several Joints. B. M. Hay. J. Bone & Joint Surg. **32-B:** 361–367, August 1950.

Two cases in teen-age boys are presented, one of bilateral osteochondritis dissecans of the patellas and of the elbows, and one of bilateral elbow disease and involvement of one knee.

Because of the bilateral and multiple distribution of the lesions, etiology is discussed from the standpoint of injury, developmental anomaly, and constitutional disturbance. In these two cases, there was no confirmation that any of these factors played a role.

Nine roentgenograms; 9 photographs.

RICHARD A. ELMER, M.D.
Emory Medical School

Osteochondritis Dissecans of the Elbow Joint. A Clinical Study. Norman Roberts and Rowland Hughes. J. Bone & Joint Surg. **32-B:** 348–360, August 1950.

It is pointed out that, while in British and American literature osteochondritis dissecans involving the elbow has only occasionally been reported, continental writers for the past twenty years have recognized a higher incidence of this condition in the elbow than in the knee. The authors believe that in England, also, the elbow is as frequently involved as the knee. They report a study of 38 cases.

Radiographically, the so-called typical appearance of an island of subchondral bone surrounded by an area of rarefaction so often seen in the knee, hip, and ankle is rarely observed in the elbow. Early changes are manifest in the anteroposterior roentgenogram as a patchy rarefaction with ill-defined limits, largely affecting the convexity of the capitellum. Less often the lesion is more easily seen in the lateral film. The next most common appearance is an irregular cyst-like change which has been likened to an early stage of Freiberg's disease of the metatarsal head. Another manifestation of the disease is a single large, rarefied or punched-out area or cavity without sequestrum, simulating the destruction of tuberculosis.

Involvement of the medial part of the convex rim of the radial head either with or without associated disease of the capitellum was discovered in 4 cases.

Whatever the original form of the disease, the vast majority of cases with loose bodies will reveal evidence

of previous osteochondritis dissecans. The most constant feature in the late stage is flattening of the capitellum.

Clinical features, operative findings, treatment, and etiologic factors are also discussed in detail.

Thirty-one roentgenograms.

RICHARD A. ELMER, M.D.
Emory Medical School

Cherubism—A Familial Fibrous Dysplasia of the Jaws. W. A. Jones, John Gerrie, and Joseph Pritchard. J. Bone & Joint Surg. **32-B:** 334–347, August 1950.

The authors give a detailed record of several members of the same family, three of whom have been observed since 1931, with a strange deformity of the mandible and maxilla. The term "cherubism" was coined by one of the authors to denote the exaggerated chubbiness of their features. Photographs and radiographs made serially over the long period illustrate the bulging jaws with expanding cysts in the bones, associated with irregularly placed deciduous teeth.

Three patients in the family were operated upon by an intra-oral approach and much of the abnormal tissue was removed so as to clear the outer aspect of the mandible down to bone. A complete removal of all involved tissue was not attempted. Grossly, the fatty, fibrous tissue seemed to blend into tougher tissue and hard bone without demarcation into cysts, and the bone was sclerotic and thick.

Fourteen roentgenograms; 14 photographs; 2 photomicrographs.

[A similar condition affecting members of two families is reported by Caffey and Williams, under the designation "familial fibrous swelling of the jaws," in Radiology **56:** 1, 1951—Ed.]

RICHARD A. ELMER, M.D.
Emory Medical School

Skeletal Lesions of Leucemic Children Treated with Aminopterin. Felix E. Karpinski, Jr., and James F. Martin. J. Pediat. **37:** 208–223, August 1950.

The occurrence of skeletal lesions in children with leukemia has been well demonstrated in many roentgen studies. The present report concerns 33 children with acute leukemia treated with aminopterin and followed roentgenographically.

Chest roentgenograms revealed abnormalities in 37 per cent. These included enlargement of hilar nodes, pleural effusion, parenchymal infiltration and hemorrhage, passive hyperemia, and pulmonary edema. Serial studies failed to demonstrate regression during aminopterin therapy.

Involvement of the skull was less frequent (22 per cent). Osteolysis was the only lesion identified and was progressive in spite of treatment with aminopterin.

The long bones revealed lesions in 81 per cent of the cases. The most common site was in the ends of the long bones. The types observed were osteolysis, subperiosteal new bone formation, and transverse bands of diminished density. Thirteen of the patients had adequate serial film studies to permit evaluation of the changes: 5 of the 13 patients had no long bone lesion at the initial examination, and in 4 of these changes developed during aminopterin therapy; 8 patients had lesions at the initial examination and, of these, 2 remained unchanged, 1 regressed, and 5 progressed despite the administration of aminopterin.

Transverse bands of increased density, present in 5 cases, appeared to be unrelated to aminopterin, and the nature of this change was not understood.

It was felt that the presence and progression of bone changes in these leukemic children showed no correlation with the clinical or hematological response to aminopterin.

PAUL W. ROMAN, M.D.
Baltimore, Md.

Benign Giant-Cell Tumors. A Report of 7 Cases in Which the Bones of the Hands and Feet Were Involved. Henry W. Meyerding and Alfred E. Jackson. S. Clin. North America **30:** 1201–1213, August 1950.

The authors present 7 cases of benign giant-cell tumor of the bones of the feet and hands, found in 500,000 patients seen over a period of thirty-two years at the Mayo Clinic. The total number of giant-cell tumors seen during this time was 130 (105 benign and 25 malignant). No malignant giant-cell tumors of the hands and feet were encountered.

A common symptom of giant-cell tumor is aching pain, later followed by visible or palpable tumefaction. The average duration of symptoms prior to diagnosis in the 105 cases of benign tumor mentioned above was nineteen months. Roentgenograms usually reveal metaphyseal and metaphyseal-epiphyseal central or asymmetric osteolytic lesions of bone which, with further growth, erode the cortex and elevate the periosteum. In later stages the periosteum may be perforated and the periosseous structures may be invaded. In rare instances the tumor may begin in the periosseous tissues and secondarily invade the bone. In the hands and feet, because of the close proximity of the bones to each other, invasion of neighboring bones by the tumor may occur and the roentgenologic appearance may simulate that of a malignant lesion.

In the authors' opinion early treatment is indicated but they feel that a positive diagnosis by biopsy is mandatory. They recommend complete surgical removal if at all possible, with curettement and placing of bone chips as a second choice. They believe that this type of treatment gives the best prognosis with minimal period of disability. Roentgen therapy is not to be ignored, but results did not appear to the authors to be as satisfactory as from surgery, and they observed a number of complications in the form of growth arrest, actinodermatitis, and aseptic necrosis.

Seventeen roentgenograms.

E. KASH ROSE, M.D.
University of Louisville

The X-ray Picture of Aseptic Necrosis of the Finger Joints. M. Steingräber. Fortschr. a. d. Geb. d. Röntgenstrahlen **73:** 220–225, June 1950. (In German)

Aseptic necrosis of the finger joints usually begins just before or at puberty and involves the midphalangeal joints of the second to fifth fingers. Six cases have been recently observed: in two brothers in one family and four sisters in another family. Both hands are involved, but the individual joints do not show the same stage of the disease; in some joints the involvement may be at a very early stage; in others, well advanced.

The condition is painless during the early developmental stage and only very mild pain occurs in the later stages. There is relatively slight disturbance of

mobility except for fine finger movements, restriction of movement being predominantly on the extension side. There may be some resulting flexure contraction of the tendons as the condition heals. Therapy is aimed at limiting the deformity, with caution in the use of the hands, and particularly avoidance of heavy work for long periods of time.

The earliest x-ray findings are observed in lateral views. The central portion of the epiphysis shows disruption of the bone structure and at a later stage very nearly disappears. On the ventral side there is epiphyseal thickening with preservation of the trabecular structure. A portion of the dorsal aspect of the epiphysis breaks off, forming a loose bone fragment. The epiphyseal closure is noted first on the ventral side and later on the dorsal, but there is never complete regeneration or return to normal. It depends on the degree of change whether the head of the proximal phalanx shows any marked deformity or irregularity about the proximal bony joint surface, with bone condensation. As the condition reaches a healing stage, there may be considerable flexion deformity and residual secondary changes of arthritis deformans.

The etiology of this condition is not understood; embolic phenomena or other circulatory changes may play a part. There may also be some measure of endocrine change, trauma, or congenital tendency as a background factor in the pathological process.

Nine roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Spondylolisthesis with an Intact Neural Arch—The So-Called Pseudo-Spondylolisthesis. Ian Macnab. J. Bone & Joint Surg. **32-B:** 325–333, August 1950.

The author reports on the clinical findings in 22 patients with spondylolisthesis without neural arch defect. Three symptom-complexes are listed: (1) backache with or without sciatica but with no sign of nerve root compression; (2) sciatica with or without backache and with evidence of nerve root compression; (3) symptoms of cauda equina compression.

In 5 of the author's cases symptoms appeared suddenly. Usually, however, onset was gradual, with low central back pain radiating transversely. Aggravation of backache in the supine position was frequent. Examination revealed restricted flexion of the lumbar spine, tenderness on deep pressure over L-4 and sometimes over another area at the lumbo-dorsal junction. Eleven patients had signs of nerve root compression. No example of cauda equina compression was seen in this series.

The fourth lumbar vertebra is most commonly affected, whereas neural arch defects are usually found at L-5. The 22 cases constituting this series were found in a review of 142 cases of spondylolisthesis, 38 of which involved the fourth lumbar vertebra. The predominance of cases without neural arch defects in this latter group suggests that anterior displacement of the fourth lumbar vertebra is as commonly due to subluxation of the posterior joints as to a defect in the neural arch. The incidence of spondylolisthesis of L-5 without neural arch defect cannot be assessed accurately, because satisfactory roentgenograms of the pars interarticularis at this level cannot always be obtained.

As the average age of the patients was sixty years, the usual roentgen picture was of an osteoporotic, osteoarthritic spine with slight anterior displacement of the fourth lumbar vetebra, but with no defect of the arch demonstrable in the oblique view. Anterior displacement in this group of 22 cases averaged 0.6 cm. and in no case exceeded 1.0 cm. Osteoarthritis was either localized to the posterior joints between L-4 and L-5 or generalized in all the lumbar posterior joints. Localized spinal fusion is indicated in early cases without nerve root compression. Laminectomy should be done for severe symptoms due to nerve root compression, without subsequent spinal fusion.

Nine roentgenograms; 8 drawings; 1 table.
RICHARD A. ELMER, M.D.
Emory Medical School

Changes in the Sacro-iliac Joints in Morbus Bechterew and Osteitis Condensans. Folke Knutsson. Acta radiol. **33:** 557–569, June 1950.

The earliest changes demonstrated roentgenographically in Bechterew's disease are in the sacroiliac joints. Subsequently the intervertebral joints are involved. The author collected all the cases with roentgenographically demonstrable involvement of the sacroiliac joints seen between 1936 and 1949 in the Orthopedic Clinic of the Karolinska Sjukhuset, Stockholm. Eliminating cases with changes referable to tuberculosis, trauma, septic processes, and tumors, he had 147 cases of Bechterew's disease and 37 of osteitis condensans ilii.

It is possible to discern three stages in the arthritic process of the sacroiliac joints in Bechterew's disease. The initial stage is manifested by opacity of the contours of the joint surfaces with an indication of sclerosis on the iliac side of the joint, but with maintenance of the joint space. The destructive stage consists of narrowing of the joint space due to cartilaginous destruction, with an increase in the juxta-articular sclerosis on the iliac side. The third, or ankylosing, stage is reached when the joint space is progressively more diminished until ankylosis is fully established. Transformation of the bony structure then takes place, with complete disappearance of the sclerosis.

In 92 of the 147 cases with sacroiliac changes characteristic of Bechterew's disease, typical changes were also demonstrated in the spine. In 7 cases typical arthritic changes were found in the sacroiliac joints but no spine changes could be demonstrated on reexamination five to eight years later. In these cases spinal mobility was fully maintained. Such cases could possibly be considered an abortive form. In 48 other cases localized to the sacroiliac joint the subsequent course was not followed.

Osteitis condensans, characterized by a more or less widespread sclerosis within the ilium and the vicinity of the sacroiliac joints, with preservation of the joint space, was found predominantly in women. Of the author's series of 37 patients, only 2 were men. The etiology is unknown. Injury during pregnancy and parturition and mild inflammation are suggested by some authors as antecedent factors.

It is necessary to take oblique views to localize sclerosis in relation to the joint space. The sclerosis is predominantly limited to the iliac side, although 5 of the patients in this series had sacral sclerosis as well.

In early cases it is not always possible to differentiate changes due to Bechterew's disease and those of osteitis condensans.

Thirty-eight roentgenograms.
WENDELL WARD, M.D.
University of Arkansas

Internal Derangement of the Talofibular Component of the Ankle. Irving Wolin, Frank Glassman, Sidney Sideman, and Daniel H. Levinthal. Surg., Gynec. & Obst. **91:** 193–200, August 1950.

The authors state that persistent or recurring pain and swelling over the fibular aspect of the ankle as sequelae to an inversion sprain are due to involvement of the anterior talofibular component of the fibular collateral ligament. Because of this, the signs are localized to a point just anterior to the external malleolus. The injury causes synovial thickening and exudation. If the exudate and hemorrhage are not completely absorbed, hyalinization occurs and the mass of hyalinized tissue assumes the appearance of the meniscus of the knee; it is called by the authors a "meniscoid." The symptoms are due to pinching of this meniscoid and are relieved by its removal. An ossicle may form in association with the meniscoid, but is not of clinical significance. The meniscoid cannot be detected radiologically. Nine cases are reported.

Twenty-two illustrations, including 12 roentgenograms.

ROBERT J. AVELLA, M.D.
University of Pennsylvania

Universal Interstitial Calcinosis. R. Clara and L. Thys. J. belge radiol. **33:** 135–155, 1950. (In French)

A 6-year-old girl presented the clinical and roentgenologic picture of universal interstitial calcinosis. She had suffered pains in the legs and in some of the joints at the age of two years, but the symptoms regressed. At the age of five years the patient had scarlatina complicated by nephritis. From that time the parents noticed limitation of movement of the hips, knees and elbows. Small subcutaneous nodules appeared near the knees, and later on the legs and arms. Later still these nodules ulcerated.

Roentgenograms revealed calcification in the interstitial tissues throughout most of the body, but most pronounced in the lower extremities. Generalized osteoporosis was also seen.

Interstitial calcinosis must be differentiated from localized myositis ossificans, calcareous metaplasias, calcareous gouty tophi, calcinosis circumscripta, Ehlers-Danlos syndrome, lipogranulomatosis, and progressive myositis ossificans.

Various theories concerning the etiology are discussed and rejected. The course is slowly progressive, terminating fatally, since no effective treatment has been found.

Eight roentgenograms; 4 photographs.

CHARLES NICE, M.D.
University of Minnesota

Skeletal Changes in Severe Phosphorus Deficiency of the Rat. I. Tibia, Metacarpal Bone, Costochondral Junction, Caudal Vertebra. R. D. Coleman, H. Becks, F. Van Nouhuys Kohl, and D. H. Copp. Arch. Path. **50:** 209–232, August 1950.

Forty-nine female rats of the Long-Evans strain, weighing 45 to 50 gm. each, were weaned at twenty-one days of age. Twenty-one rats were given a phosphorus-deficient diet, 20 were pair-fed a phosphate-supplement diet, and 8 were offered this control diet *ad libitum*. The experimental as well as the control rats received 8 U.S.P. units of vitamin D and 20 U.S.P. units of vitamin A per gram of diet. The experimental animals were arranged in four groups according to age and duration of deficiency. Those of Group 1 were killed at 45 days, of Group 2 at 53 days, of Group 3 at 62 days, and of Group 4 at 70 days of age, after experimental periods of 24, 32, 41, and 49 days, respectively.

Roentgenograms of the carcasses of the phosphorus-deficient rats revealed an extreme lack of mineralization. The only well mineralized structures observed were the teeth, which were calcified prior to the beginning of the experiment. Growth of the animals was severely stunted.

In each of the four groups the average tibia length of the phosphorus-deficient rats was less than that of the pair-fed and *ad libitum* controls. The diameter of the shaft of the deficient tibia at its midpoint and the width of the cortical bone were less than in the pair-fed rats. The epiphyses of the deficient rats were club-shaped, with the abrupt junction with the diaphysis characteristic of severe rickets. In contrast to this, the epiphyses of the pair-fed and *ad libitum* rats tapered gradually into the diaphysis. The epiphyseal cartilage was very wide, and in the metaphysis the trabeculae were poorly mineralized. In the tibias of the two control series the epiphyseal cartilage was narrow and the trabeculae were well ossified and distinctly visualized.

The roentgenograms of the forepaws of the phosphorus-deficient rats when compared with those of the controls showed similar changes, namely, a lack of mineralization, shorter and narrower bones, and an increase of width in the non-mineralized epiphyseal cartilage and metaphysis. The forepaws of the control rats were well developed and mineralized and the width of the epiphyseal cartilage appeared normal.

The roentgenographic appearance of the ninth caudal vertebra in the phosphorus-deficient rats was characteristic of rickets. As compared with the controls, the maturation of the vertebra was severely retarded. In both the proximal and distal epiphysis the secondary ossification centers appeared as two small radiopaque areas. In the controls these centers united and formed the completed epiphysis. The lack of growth of the ninth caudal vertebra was marked. The vertebrae of the pair-fed control rats were smaller than in the *ad libitum* controls as a result of the limited food intake.

Histologic studies of the tibia, metacarpal bone, caudal vertebra and costochondral junction showed signs of rickets in all four bones. The following changes were observed in the epiphyseal region: (*a*) increased width of the epiphyseal cartilage; (*b*) lack of a provisional zone of calcification; (*c*) failure of epiphyseal cartilage to be resorbed; (*d*) compression of chondrocytes; (*e*) formation of osteoid tissue; (*f*) lack of remodeling resorption of osteoid matrix; (*g*) blood vessel invasion of the cartilage with osteoid matrix replacing it at approximately 60 to 70 days.

While an increase in the Ca : P ratio from 28 : 1 to 78 : 1 did not appear to intensify the severity of rickets in these animals, definite changes were observed with increasing age and time on the low-phosphorus diet.

The gross deformities of the bones in rickets may be attributed to the failure of the intercolumnar matrix and osteoid matrix to calcify. Remodeling resorption also fails to take place and the volume of osteoid is increased.

Twelve roentgenograms; 21 photomicrographs; 4 tables.

GYNECOLOGY AND OBSTETRICS

Hysterography and Hysterosalpingography. An Analysis of 2,500 Cases with Special Emphasis on Technique and Safety of the Procedure. Richard H. Marshak, Charles S. Poole, and Morris A. Goldberger. Surg., Gynec. & Obst. **91:** 182–192, August 1950.

Twenty-five hundred cases in which hysterography and hysterosalpingography were used are analyzed. Fourteen hundred of the examinations were done in Mt. Sinai Hospital, New York City, and the remainder by the authors in the course of their private practices. The indications for uterosalpingography in these cases were: (1) menometrorrhagia, (2) dysmenorrhea, (3) sterility, (4) fibroid uterus, (5) postmenopausal bleeding. Contraindications to the procedure were pelvic inflammatory disease, intrauterine pregnancy, a purulent vaginal discharge, and the presence of serious constitutional disease.

The technic of the procedure and the advantages of the various radiopaque substances used are discussed. Complications due to the contrast medium were: (1) pain, (2) peritonitis, (3) endometritis, (4) allergic phenomena, and (5) emboli. Those due to the procedure itself were: (1) hemorrhage, (2) acute exacerbation of chronic inflammatory disease, (3) perforation of the uterus, (4) shock, (5) entrance of the dye into the uterine vascular structure, (6) introduction of the medium into a pregnant uterus. All of these complications are discussed and analyzed.

Several illustrative cases are reported.

Fourteen roentgenograms.

ROBERT J. AYELLA, M.D.
University of Pennsylvania

Clinical Evaluation of X-ray Pelvimetry. A Study of 1,000 Patients in Private Practice. Isadore Dyer. Am. J. Obst. & Gynec. **60:** 302–313, August 1950.

Dyer studied 1,000 private patients who had had x-ray pelvimetry and had been delivered by him or by one of a small associated group; 850 of the patients were primigravidas and 150 were multiparas. There were 32 contractions of the inlet in the series, but they presented no clinical problem. Outlet contractions (17 in the series) were not found alone, and the outlet was easily accessible to clinical measurement and evaluation. Midplane contractions were the most frequent pelvic abnormality in the series (197 cases) and presented the most difficult clinical problems.

The author feels that clinical evaluation of the midplane diameters is consistently inadequate, leaving the roentgen method the most accurate means of measurement here. The Mengert and the transverse-posterior sagittal indices were utilized with some success in evaluating midplane disproportion, but exceptions were found to both. Estimations of the volume of the fetal head and maternal pelvis proved helpful in cases of questionable bony disproportion.

The studies showed that in normal pelves disproportion is due to large fetal heads. In contracted pelves, it is due to the small pelvic diameter. Greater apparent disproportions are compatible with vaginal delivery in patients with normal pelves, since a large fetal head can be expected to mold to a greater degree than a small one.

Six charts; 5 tables.

T. FREDERICK WEILAND, M.D.
Jefferson Medical College

A Method of Locating the Placenta in the Intact Human Uterus by Means of Radio-active Sodium. J. C. McClure Browne and N. Veall. J. Obst. & Gynaec. Brit. Emp. **57:** 566–568, August 1950.

After reviewing briefly the various procedures for locating the placenta in the intact human uterus, the authors describe a simple new method using radioactive sodium. Approximately 50 microcuries of radioactive sodium, Na^{24}, in the form of 5–20 ml. of sterile isotonic saline, are injected into a suitable antecubital vein. After about thirty seconds, radioactivity measurements are made over the abdomen. The counting rate over the area of the uterus and other regions is measured with the end of the counter tube in contact with, and with the axis normal to, the skin. From time to time the counter is placed over the heart, and the observed reading taken as a reference level. The counting rate over the fundus of the uterus is about one-half to two-thirds of that observed over the heart, and is slightly higher on the right side owing to the radiation from the liver. The observed counting rate decreases rapidly toward the lower uterine pole, and over the lower segment of the uterus it is only about one-fifth of that over the heart.

The method depends on the fact that the placenta is essentially a pool of blood and therefore represents a local accumulation of Na^{24} so long as the bulk of the isotope remains in the circulation. However, since the Na^{24} rapidly diffuses out of the vascular system, useful observations can be obtained only within a few minutes of the injection. When the placenta is situated on the anterior wall of the uterus, its site is indicated by a region where the counting rate is considerably higher than that over the uterus generally, and is almost equal to that observed over the heart. If such a region is not found, it is concluded that the placenta is located on the posterior wall. In cases of posterior location where the placenta is not centrally situated, it is usually possible to determine on which side it lies by differences in the counting rate.

This method is at present chiefly applicable to the problem of obtaining maternal placental blood for analysis and is of little value in the diagnosis of placenta praevia, but the possibility of development of an isotope method of diagnosis of this condition is envisaged.

The Urinary Bladder During Parturition: A Consideration of Its Location, Injury, and Repair. Sidney Cohn and Arthur Weinberg. Am. J. Obst. & Gynec. **60:** 363–370, August 1950.

The authors were interested in determining the position of the bladder during labor. To do this they studied 5 patients, obtaining for each lateral cystograms during the first and second stages of labor. In one of the two films in each case the bladder was "full" (containing 300 c.c. of 4 per cent sodium iodide) and in the other it was "empty" (containing 40 c.c. of 4 per cent sodium iodide). It was found that the full bladder was both an abdominal and a pelvic organ during the first and second stages of labor. The larger portion is abdominal, but a pelvic portion was seen to persist throughout labor on all films.

The arguments for and against routine catheterization before instrumental vaginal delivery are summed up. Since those against catheterization seem to rely on the idea that the full bladder becomes an abdominal organ during labor, the authors do not consider them valid. Routine catheterization is recommended.

Three cases of vesicovaginal fistula and one case of urethrovaginal fistula—all resulting from trauma during forceps deliveries—are reported. The authors recommend immediate repair of such lacerations.

Four roentgenograms; 2 tables.

T. FREDERICK WEILAND, M.D.
Jefferson Medical College

THE GENITO-URINARY SYSTEM

Is Intravenous Pyelography Used Too Frequently? Earl B. Sanborn. Urol. & Cutan. Rev. **54:** 468–471, August 1950.

The clinical records and roentgenograms of 200 consecutive patients in whom intravenous pyelography was done were examined. The pyelograms were classified as normal, pathological, inconclusive, and of no value.

Thirty-seven per cent of the patients were considered to have normal pyelograms. Some of those in this group, however, had definite urinary tract disease which was not revealed roentgenographically. An example of this was a patient with painless hematuria in whom a bladder tumor was discovered by cystoscopy after a normal intravenous pyelogram.

Twenty-two per cent of the cases fell into the pathological classification.

The inconclusive group comprised all cases in which the x-ray films failed to demonstrate either normal findings or a definite lesion. Thirty-two per cent of the series came under this heading. In a number of these cases the patient was prepared according to the usual routine but the kidneys and their pelves were obscured by gas and other intestinal contents. In some the excretion of dye was so poor that details of the collecting systems were lacking.

Pyelograms which failed to visualize the renal collecting systems were designated as "of no value." Nine per cent of the cases were in this group.

Inasmuch as approximately 40 per cent of the roentgenograms were inconclusive or of no value, it is logical to conclude that excretory urography is not always satisfactory as a diagnostic aid.

Intravenous pyelography was superior in only one-ninth of the cases in which both retrograde and intravenous pyelography were done, whereas retrograde pyelography was superior in over two-thirds of the cases. The author lists the following reasons why retrograde pyelography and cystoscopy are superior to excretory urography. (1) The lower urinary tract is directly examined and visualized. (2) Specimens of urine may be obtained separately from the bladder and the individual kidneys for culture and examination. (3) "Split function" tests of the kidney may also be done, using either indigo carmine or phenolsulfonphthalein. (4) The sources of hematuria or pyuria may be found directly. (5) The opacity of the retrograde pyelograms is greater because the dye is of stronger concentration. (6) Greater detail is demonstrated by the retrograde pyelogram. (7) Gaseous distention does not interfere with the appearance of the retrograde pyelogram as it does with the excretory type. (8) Retrograde pyelography does not depend on renal function. (9) There have been no unfortunate sequelae of an allergic nature following retrograde pyelography in which accepted contrast media have been used.

In only one-fourth of the 120 patients found to have disease of the urinary tract was the diagnosis aided by intravenous pyelography. Cystoscopy combined with retrograde pyelography was responsible for making the diagnosis in over one-half of the cases.

Three-fifths of the pyelograms on unselected hypertensive patients were inconclusive or of no value. The routine use of excretory urography in these patients can therefore be questioned.

The author's conclusions from this study are as follows.

Excretory urography is used more today than is warranted. This supports the conclusions of others, who concur in the opinion that it is only one of the diagnostic procedures to be used for examination of the urinary tract.

Cystoscopy and retrograde pyelography were found to be of greater value in the diagnosis of lesions of the entire urinary tract than intravenous pyelography. Their utilization should therefore be increased. In addition, the results indicate that intravenous pyelography does not constitute a complete examination of the urinary tract.

A non-protein nitrogen determination or renal function test, a plain film of the abdomen for kidneys, ureters, and bladder, and a urinalysis (catheterization in female patients) should precede the decision to obtain an intravenous pyelogram.

Persistent pyuria and all types of hematuria are indications for a complete urological investigation (cystoscopy and retrograde pyelography unless contraindicated). An elevated nonprotein nitrogen determination and inability of the kidneys to concentrate well preclude good results from intravenous pyelography.

The early diagnosis of bladder tumors and other malignant lesions of the urinary tract can be made only by the more frequent use of cystoscopy and retrograde pyelography.

Routine use of excretory urography in the study of a patient with hypertensive cardiovascular disease is unwise. Retrograde pyelography combined with excretion studies should be used more frequently in this group.

One table.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Improved Pediatric Excretory Urography. L. P. Matthei. J. Urol. **64:** 417–420, August 1950.

The presence of intestinal gas often obscures the urinary system and increases the difficulty of obtaining satisfactory urograms in children. The author dehydrates his patients for twelve hours prior to excretory urography except where this is definitely contraindicated. He then takes a scout film and next injects the medium intramuscularly or intravenously. Immediately thereafter an 8-ounce bottle of the usual formula or a glass of milk is offered the patient. Then the routine of obtaining films is continued.

With this method there is a layering of air and fluid in the dilated stomach overlying the kidneys. This causes displacement of the air-filled small and large bowel and, surprisingly, allows a clear and unobstructed view of the upper urinary tract. Thirteen roentgenograms show this method to provide adequate visualization of the upper urinary tract.

JACK EDEIKEN, M.D.
University of Pennsylvania

Differential Diagnosis Between Renal Tumor and Renal Cyst. George C. Prather. J. Urol. **64:** 193–199, August 1950.

The purpose of this paper is to point out some criteria for the differential diagnosis between renal tumor and renal cyst. A history of pain is uncommon with cysts, but is present in 22 to 30 per cent of cases of tumor. Hematuria is also rare with cysts, while it may be present in 32 to 40 per cent of patients with tumor. Physical examination is not very fruitful diagnostically, but an attempt should be made to palpate renal masses, especially for fixation or nodulation. Low-grade pyrexia may occur in as many as 20 per cent of the tumor cases and should be looked for. It occurs but rarely with cysts. One of the best diagnostic aids is the Papanicolaou smear for tumor cells; repeated positive tests are most helpful. Calcification is evidence of a tumor, occurring in up to 15 per cent of the cases; renal cysts rarely show calcification. Retrograde pyelography is more informative than an intravenous study. Aortography is a useful procedure, as is a diagnostic tap.

If a definite diagnosis cannot be established by the above means, exploratory operation should be undertaken. It is to be noted that cysts and tumors may occur together.

Seven roentgenograms; 1 photograph.

JOHN M. PHILLIPS, M.D.
University of Pennsylvania

Diagnostic and Therapeutic Considerations in Renal Aneurysm, with a Report of Two Additional Cases. Robert F. Sharp and Max M. Green. J. Urol. **64:** 214–223, August 1950.

The authors report two cases of renal aneurysm, bringing the total number in the literature to 93. In only 17 had a positive diagnosis been made prior to surgery or autopsy. This number includes the authors' 2 cases, one of which was diagnosed tentatively and the other absolutely before operation.

An analysis of the reported cases revealed little of diagnostic usefulness. The sexes are about equally represented. The incidence was highest in the fifth and sixth decades, though the condition occurs at all ages. Certain symptoms and signs were fairly common but not associated in a characteristic syndrome. In the 93 cases, pain was present 53 times, hematuria 38 times, a mass 29 times, tenderness 20 times, and a pulsating mass or systolic bruit 10 times. Shock was noted 17 times, always in association with massive bleeding.

The most useful diagnostic finding, though it was present in only 18 of the 93 cases, was the roentgenologic demonstration of a ring-like calcification near the hilus of the kidney. This ring of calcification, which is due to calcific deposits in the wall of the aneurysmal sac, is usually broken at one point on its circumference. This contour break represents the connection of the aneurysm with the renal artery.

The calcification in renal aneurysms must be differentiated from calcified cysts of the kidney, pancreas or spleen, calcified abscess or hematoma, renal calculi, gallstones, and calcified neoplasms. Lateral pyelograms, laminagrams, and aortic arteriography are useful in differentiation. When shock and severe pain occur, renal aneurysms must be differentiated from other acute abdominal conditions.

Surgery is the only logical procedure, since nonsurgical treatment is attended by a mortality rate of 100 per cent.

Six roentgenograms; 1 drawing.

JOHN M. DENNIS, M.D.
University of Pennsylvania

THE BLOOD VESSELS

An Improved Method of Venography for the Preoperative Evaluation of the Postphlebitic Extremity. Raymond S. Martin and Robert S. McCleery. Surgery **28:** 322–340, August 1950.

The authors state that venograms have value in the solution of three of the most common problems involving the lower extremity, permitting an evaluation of patients with a history suggestive of, and physical findings compatible with, a former episode of deep vein thrombosis.

(1) In those found to have a normal deep venous circulation, attention may be directed to treatment of local lesions and superficial varicose vein disorders.

(2) Problems of complete deep venous obstruction may be separated from those of partial obstruction or recanalization. Unnecessary deep vein exploration in the former is avoided and therapy may be directed to that portion of the collateral system responsible for symptoms.

(3) Determination of which deep veins below the knee connect directly with the tributaries of the recanalized femoral vein may be made. This indicates the ligation of those veins necessary to relieve the orthostatic effect on the involved extremity.

Following testing for sensitivity to diodrast, a 19- or 20-gauge needle is inserted into a dorsal foot vein or the greater saphenous vein below the internal malleolus. To the needle is attached a 12-inch piece of small-caliber rubber tubing which has at its other end a three-way stopcock. The needle is fixed in position with adhesive. To the free arm of the stopcock is attached an intravenous infusion set containing physiologic saline solution. This fluid serves to keep the needle and venous channels patent, and to flush the veins free of dye following injection. Two x-ray units are employed simultaneously, a permanent tube over the upper thigh and inguinal region and a portable over the leg, with a lead shield hanging between the two fields to prevent stray radiation. A rubber tube tourniquet is placed around the leg just above the malleoli, obstructing only the superficial veins, and 34 per cent diodrast solution is injected rapidly. With the leg and foot everted, a lateral film of the leg alone is made after injection of 15 c.c. The leg is then returned to its anteroposterior position, the film beneath the leg is quickly changed, the remaining 15 c.c. of dye are injected, and simultaneous anteroposterior exposures of the leg and thigh are made.

If evaluation of these films reveals adequate filling and outline of a normal deep venous circulation, it is unnecessary to make any further exposures. However, additional evaluation may be required in those cases in which the original set of films reveals obstruction or incomplete filling of the deep veins. This may be due to passage of an appreciable portion of dye through the superficial system and/or other collateral channels. In this event, a second anteroposterior set of films of leg and thigh are obtained. In addition to the ankle

tourniquet as before, a blood pressure cuff is wrapped about the lower thigh and inflated to a pressure of 40 to 45 mm. of mercury, and 30 c.c. of diodrast are injected. The authors have found this the minimal pressure necessary to insure obliteration of the superficial veins at this level, thereby forcing all possible contrast medium through the deep circulation. Diodrast which may have entered the superficial collateral channels below the level of the cuff is thereby diverted again into the deep veins.

The authors discuss the interpretation of findings on films made by the above technic and present 6 cases. They have used this method to study 75 clinical problems, including all types of chronic venous lesions of the lower extremity, with good correlation between physical, x-ray, and operative findings.

Twenty venograms, with corresponding drawings; 2 photographs; 1 photomicrograph; diagram of the injection technic.

WILLIAM H. SMITH, M.D.
University of Louisville

Abdominal Aortic Aneurysm: A Study of One Hundred and Two Cases. J. Earle Estes, Jr. Circulation **2:** 258–264, August 1950.

An analysis of 102 cases of abdominal aortic aneurysm is presented. Arteriosclerosis was the etiologic basis for the aneurysm in 97 cases. The most common symptoms were abdominal pain and the presence of a mass, but nearly a third of the patients were asymptomatic. The usual physical signs were the presence of an expansile, pulsatile abdominal mass and a thrill or bruit.

Appropriate roentgenograms were obtained in 78 of the 102 cases. In 67, or 85.9 per cent, the roentgenograms disclosed evidence pathognomonic of or compatible with the diagnosis of abdominal aortic aneurysm. The most frequent roentgen finding was scattered plaques of calcification in the wall of the aneurysm or in the aorta. This occurred in 52 of the 67 cases. A soft-tissue mass, aneurysm, or enlarged aorta was demonstrable in 36 cases. Curvilinear, linear, or laminated calcification was shown in 8 cases, and erosion of bone (vertebra) in 5 cases. Displacement of the esophagus, stomach, duodenum, and left ureter occurred in 4 patients, respectively.

Fluoroscopic examination in suspected cases of abdominal aortic aneurysm was of no significant value except occasionally when it showed displacement of certain viscera after the ingestion of barium.

Seven roentgenograms; 1 graph; 4 tables.

DANIEL WILNER, M.D.
Atlantic City, N. J.

Catheterization of the Portal Vein in Man Following Porto-Caval Anastomosis. Charles T. Dotter, Mary Ann Payne, and Ward O'Sullivan. Ann. Surg. **132:** 310–311, August 1950.

In the case reported in this brief paper the inferior vena cava was anastomosed to the portal vein to reduce the portal hypertension caused by a Laennec's cirrhosis, which in the past had produced episodes of melena and hematemesis. Two weeks after the anastomosis, a cardiac catheter was introduced into the left saphenous vein and passed up along the inferior vena cava to the region of the opening of the portal vein at the level of the 12th dorsal body, under fluoroscopic control. Thirty cubic centimeters of 75 per cent neo-iopax were injected and a film exposed, which showed the portal vein and its ramifications.

This method has possible value for study of the composition of portal venous blood and in demonstrating the patency of a porto-caval anastomosis.

One roentgenogram; 1 drawing.

CORNELIUS COLANGELO, M.D.
Chicago, Ill.

TECHNIC

Practical Roentgenographic Importance of Reciprocity Law Failure. Arne Frantzell. Acta radiol. **34:** 6–16, July-August 1950.

The difficulty involved in experiments in precise roentgen film sensitometry are brought out by the author. A usual method is to expose a film of known characteristics alongside the new film in the same cassette. The film showing the more graduated image is then said to be the more sensitive. Unexpected and misleading results may, however, be obtained by this method. As performed by the author, it gave contrary results when the object exposed was a chest in one case and a pelvis in another. The obvious conclusion was that the length of exposure was an important factor accounting for the difference.

To investigate this matter further, a copper step-wedge was used. The cassette containing the two film samples, with the step-wedge superimposed on it, was exposed at various distances, the time being varied according to the inverse-square law. Again it was demonstrated that film A was more sensitive for short exposures and film B more sensitive for long exposures. It was felt that the difference in the photographic effect was due to failure of the reciprocity law in the form of a so-called Schwarzschild effect, which was more noticeable in film A than in film B.

In 1899 Schwarzschild stated that the photochemical effect should not be assumed to be equal to the light intensity (I) multiplied by the time (t) but actually to $I \times t^p$, where p is usually less than unity. Not only does p vary from emulsion to emulsion, but it is not even constant for the same emulsion in different ranges of light intensity.

Only in recent times has the cause for the Schwarzschild effect been understood. When reciprocity law failure occurs, it is due to the fact that the latent photographic image is not produced in the light-sensitive emulsion unless several quanta of light are absorbed by the sensitive crystals of the emulsion. In a long exposure, the action of some of the absorbed quanta may recede before a sufficient number are absorbed to become developable. This apparent instability of the emulsion will then be greater as the exposure time increases. This is true with radiation having low content of energy, *i.e.*, with a low frequency. With visible light, a developable image occurs with absorption of a few hundred to one thousand quanta. Here absorption occurs within the halide ions with an electron split off with each quantum absorbed. In photography with high-energy radiation, such as direct roentgenography, a single quantum of radiant energy may split off perhaps one thousand electrons from a similar number of halide ions. There is no reciprocity law failure here, and the Schwarzschild exponent is unity.

To determine whether it was actually a Schwarzschild effect that caused the films in the experiments described above to show varying sensitivity differences with dif-

ferent exposure times, a copper step-wedge was exposed without intensifying screens. No difference in sensitivity was demonstrated with change in time of exposure. Decreased sensitivity was noted in both films with increased distance, due to increase in atmospheric absorption only.

The practical application of this demonstration is that, if one wishes to compare the sensitivity of two film brands or types, as was done by the author, one should use a short as well as a long exposure time, as the conclusions obtained hold true only for the time of exposure used in the experiment. Then a decision might be made as to whether one emulsion might better be used for short exposures and another for long exposures.

A more satisfactory emulsion would be one which gave satisfactory sensitivity to both short and long exposures used in the ordinary diagnostic range.

Two roentgenograms; 2 charts.

JOHN S. SCOTT, M.D.
Indiana University

RADIOTHERAPY

Treatment of Tumors of the Pineal Body. Experience in a Series of Twenty-Two Cases. Gilbert Horrax. Arch. Neurol. & Psychiat. **64:** 227–242, August 1950.

A report on 22 cases of pineal tumor seen during 1932–48 emphasizes the far better results and the greater safety of irradiation following subtemporal decompression as compared with surgical removal.

In 13 histologically proved cases surgical removal was attempted and the only 2 patients who survived five years or more had both received postoperative roentgen therapy. One patient, living and well twelve years after surgery, had "a series of high-voltage roentgen treatments" in a six-day period; the other, living and well five and a half years after surgery, also received high-voltage roentgen treatments, a total of 2,100 r being delivered through each of 2 ports to the pineal region" in a six-day period. Both of these tumors were pinealomas.

Nine cases not histologically verified gave ventriculographic evidence of pineal tumor, revealing a sharp rounded defect projecting into the posterior portion of the third ventricle and dilatation of the lateral ventricles. Five of the patients showed neurologic data almost pathognomonic of a lesion in the pineal area, *i.e.*, Argyll-Robertson pupils and loss of conjugate movements of the eyeballs above the horizontal plane. In 8 of the 9 cases a subtemporal decompression was followed by x-ray therapy, which is outlined in detail for one case as follows: "The patient received 5 series of roentgen treatments.... Each series consisted of four applications of 750 r each to either side of the head directed toward the pineal region." Six patients are living and well, except for diabetes insipidus in 2, for periods ranging from two to seventeen years.

The ninth patient received x-ray therapy without previous decompression. An acute upset in this case required interruption of treatment, but it was subsequently completed, and the patient is living and well, except for diabetes insipidus, ten years later.

Occasionally, a second course of x-ray therapy was given seven to eight weeks after decompression but, as a rule, the signs and symptoms of increased intracranial pressure subsided after the initial course.

CORNELIUS COLANGELO, M.D.
Chicago, Ill.

Intravaginal Roentgen Therapy of Carcinoma of the Cervix. Preliminary Report on 14 Cases. Tom B. Bond and Maurice C. Archer. Texas State J. Med. **46:** 646–650, August 1950.

For carcinoma of the cervix, intravaginal therapy has been used by the authors in combination with intracervical radium and external roentgen therapy in moderate dosage.

Following intracervical radium application for 3,000 mg. hr., intravaginal cone therapy was instituted, according to Bouslog's multiple port technic (Am. J. Roentgenol. **57:** 665, 1947. Abst. in Radiology **50:** 565, 1948). The factors were as follows: 200 kv., 25 ma., 0.5 mm. Cu and 1.0 mm. Al filtration, 41 cm. distance. The dosage was 4,000 r directly to the cervix, 4,000 r to each lateral fornix, and 2,000 r each to the anterior and posterior edges of the cervix, directed toward the bladder region in the former instance and slightly toward the rectum in the latter. [The size of the fields and the method of fractionation are not stated.] External therapy was given through five ports at 220 kv., 20 ma., 50 cm. distance, with Thoraeus filter [thickness not given]. The dosage was 1,500 to 2,000 r per port.

Fourteen case reports are given, but the longest follow-up period is about eighteen months. More time will be needed to determine the incidence of fistulae, but certainly intravaginal therapy is a valuable weapon in the treatment of pelvic carcinoma.

Two charts; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Cancer of the Cervix Uteri: Sydney Hospital Figures for Fifteen, Ten and Five Year Periods from 1929 to 1943. H. K. Porter, A. R. H. Duggan, S. D. Bray, and R. S. Ford. M. J. Australia **2:** 277–281, Aug. 19, 1950.

The results of radiation treatment of 265 histologically proved cases of cancer of the cervix uteri seen at the Sydney Hospital (Sydney, Australia) for the period 1929 to 1943 are presented.

The technic varied over three periods: (1) prior to 1933, (2) 1933 to 1938, and (3) from 1938 on. Since 1938, a modification of the Manchester technic has been used. Dosage was empirical until 1938 and ranged from 5,500 to 8,000 mg. hr., 50 to 75 mg. of radium being used over a period of 80 to 100 hours in one session. It was calculated that these earlier methods yielded 14,000 to 21,000 gamma roentgens "at point A." In spite of this high dosage, few excessive rectal reactions were noted.

From the end of 1938, the majority of patients received a dose of 9,000 r at point X (1.3 cm. out from the distal active end of the radium tube in the cervical canal) and 7,200 r at point X′ (1.7 to 1.8 cm. from the same place). After 1933, roentgen therapy was given routinely to four pelvic fields. Roentgen therapy was started from a few days to four weeks after removal of the radium. The dosage administered

to each field was usually 2,600 to 2,800 r measured on the skin with back-scatter. The factors employed were 275 kv., 5 ma., 60 cm. distance, filtration of either 3 mm. Cu plus 2 mm. Al (h.v.l. 3 mm. Cu) or 4 mm. Cu plus 2 mm. Al (h.v.l. 3.4 mm. Cu).

Five-year survival rates for patients treated radiotherapeutically were as follows: 1929 to 1933, 21.9 per cent; 1934 to 1938, 33.9 per cent; 1939 to 1943, 33.9 per cent; and for the entire period, 1929 to 1943, 32.1%.

Five-year survival rates for patients treated with both radium and roentgen therapy during the period 1929–1933 were 20 per cent and for the period 1934–1938, 39.2 per cent. The increase of 19.2 per cent was attributed to improvement in technic.

Five figures; 6 tables.

RODERICK L. TONDREAU, M.D.
Lincoln, Neb.

Carcinosarcoma of the Uterus, with Report of Case. M. Pinson Neal, Charles E. Horton, and Karl D. Dietrich. South. M. J. **43:** 693–696, August 1950.

Carcinosarcoma is a rare type of embryologically mixed mesodermal tumor with morphological features of both carcinoma and sarcoma, containing unusual elements such as cartilage, bone, muscle, myxomatous and fibrous tissue. The following is a summary of the existent theories as to their pathogenesis:

(1) A carcinoma and a sarcoma begin as separate tumors and fuse by growth continuity, "a collision tumor."

(2) At the point where a sarcoma reaches the endometrial surface a carcinoma develops secondarily.

(3) A common irritant produces a neoplasm of malignant epithelial and connective-tissue elements, both invasive in character.

(4) A multipotent cell rest may become neoplastic, that is, two tumors arise from a common stem cell. They have been termed "combination tumors."

(5) By metaplasia, one germinal layer may be partially transformed to another. This, however, has not been observed and most authorities think the transformation improbable.

Most of these tumors originate on the posterior wall of the uterus and are friable and polypoid in shape. The carcinomatous element is manifested by atypical glandular proliferation, peripheral and invasive growth, hyperchromatism, often anaplasia and mitotic figures. The sarcomatous elements may be of the round-, oval-, spindle-, or mixed-cell type and show mitoses of any of these cell types. Often cartilage, bone, and muscle elements may be identified.

Clinically, this tumor usually appears in nulliparous patients at or near the menopause. Vaginal discharge with a foul odor, uterine enlargement, and metrorrhagia are the common symptoms. Both sarcomatous and carcinomatous elements are found in the metastatic lesions and, as would be expected, the sarcomatous elements metastasize first.

The authors report what they believe to be the fifteenth case of carcinosarcoma of the uterus. The patient gave a history of metrorrhagia. On the third dilatation and curettage, a diagnosis of carcinosarcoma was made. During the course of attacks of menorrhagia and metrorrhagia 3,000 r was given in four divided doses. The authors suggest that multiple curettages and x-ray therapy may have played an etiologic role or have been partly responsible for the anaplasia in this case. However, the history of prolonged uterine symptoms and the histological findings point to a possible primary benign mixed tumor which underwent malignant change.

The general plan of treatment for such tumors is radical panhysterectomy followed by irradiation therapy. This patient survives and reveals no evidence of recurrence or metastasis following this procedure.

One photograph; 4 photomicrographs.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Intracavitary Radium at Time of Vaginal Plastic Operation. Lennard L. Weber. Am. J. Obst. & Gynec. **60:** 371–377, August 1950.

The author carefully analyzes 131 consecutive cases in each of which, in conjunction with a vaginal plastic operation (because of some injury incidental to childbirth), intracavitary radium was used for benign uterine disease. Each patient in this series underwent cervical dilatation and uterine curettage as a preliminary to operation. The majority of patients (82.4 per cent) who received radium were thus treated to bring about cessation of some form of abnormal uterine bleeding.

Over a period of twenty years the considered optimum dosage for a radium-induced menopause had ranged from 1,200 to 2,400 mg. hr., but the author found 1,200 mg. hr. adequate in all cases. Only one patient exhibited post-irradiation uterine bleeding, and that was estrogen-induced.

In one patient a papillary adenocarcinoma of the ovary developed fifteen years after the intra-uterine application of radium, but no carcinoma of the endometrium was found during a follow-up of one to twenty years.

The significant observation is that in no instance was there delayed healing, wound breakdown, or complications other than those of the immediate postoperative period frequently noted following vaginal plastic operation without radium. This study reveals no reason to avoid the use of intracavitary irradiation at the time of vaginal colpoplasty.

Two charts; 7 tables. ROBERT H. LEAMING, M.D.
Jefferson Medical College

Dose Measurements on Contact-Therapy Tubes. W. J. Oosterkamp. Acta radiol. **33:** 491–506, June 1950.

The author presents a very careful analysis of contact therapy dosimetry utilizing a Philips contact therapy tube at 50 kv. constant potential, 2 ma., with no added filter, with 1 mm. Al added filtration, and with 2.5 mm. Al added filtration. The absorption characteristic of the radiation in aluminum was first determined and thereafter the half-value-layer for different filters. The field distribution with and without a compensating filter was investigated. The author then determined depth dose data and isodose curves in a water phantom and describes the influence of secondary radiation from the applicator and the dose rate of stray radiation around the tube, caused by scattering from the patient. A dynamic electrometer proved useful in these experiments.

The author's measurements and those reported by

other investigators as far back as 1937 are tabulated for comparison and the differences are discussed.

The text is supplemented by 4 tables, 5 graphs, and isodose curves. The author has demonstrated graphically how the isodose curves were constructed.

I. MESCHAN, M.D.
University of Arkansas

Beryllium Window Radiations for Superficial Therapy. Anthony C. Cipollaro. Arch. Dermat. & Syph. **62:** 214–221, August 1950.

The author discusses the important points in the treatment of dermatologic conditions with radiations from beryllium window tubes. He believes that such radiations can be used for treating all the dermatoses that are ordinarily treated with roentgen rays, including the cutaneous neoplasms and scalp disorders requiring epilation. An apparatus with a beryllium window tube has the essential mechanical and physical properties of grenz ray, contact, and conventional superficial therapy apparatus. The penetration of the radiating beam is governed by the use of filters and by voltage. It is pointed out that the half-value layer is 0.06 mm. Al when one is using 30 kv. and no filter. By interposing a filter of 3.0 mm. aluminum and using 100 kv., one increases the half-value layer to 3.0 mm. Al. Thus, the adaptability of an apparatus having an x-ray tube with a beryllium window makes it a most desirable unit for routine superficial therapy.

While x-ray equipment with beryllium window tubes will not revolutionize superficial radiotherapy, it will give to dermatologists an apparatus of great versatility and a type of radiation which is more suitable for everyday roentgen therapy of cutaneous lesions than that previously available. By slight changes in voltage, current, and filter, made in a matter of seconds, the optimum quality of the roentgen ray beam can be selected for lesions of various depths.

Three figures.

Absorption of Roentgen Rays with Use of a Beryllium Window Tube. M. F. Engman, Jr., E. P. Weber, and W. G. Elle. Arch. Dermat. & Syph. **62:** 222–227, August 1950.

Preliminary studies of the absorption of roentgen rays from a beryllium window x-ray tube in the first 4 mm. of tissue, with polystyrene (density 1.05 to 1.08) as a phantom, are reported. Three aluminum absorption curves are reproduced, which show that the half-value layer at 30, 50, and 100 kv. (peak) is 0.05 mm. of aluminum with unfiltered roentgen rays. A table gives half-value layers at various peak kilovoltages and filtrations. Five other curves representing the amount of roentgen rays absorbed in the first 4 mm. of tissue are also reproduced. Even at 100 kv. (peak) without filtration, over half of the roentgen ray beam is absorbed. There is still greater absorption at peak kilovoltages of 50 and 30.

Air absorption, back-scatter, and the erythema dose are discussed briefly.

RADIOISOTOPES

Index of Thyroid Function: Estimation by Rate of Organic Binding of I^{131}. Glenn E. Sheline and Dwight E. Clark. J. Lab. & Clin. Med. **36:** 450–455, September 1950.

In 1949, Clark, Moe, and Adams (Surgery **26:** 331, 1949. Abst. in Radiology **55:** 317, 1950) presented a study of the conversion of orally administered inorganic radioactive iodine into plasma protein-bound iodine in patients with various thyroid states and in patients with cardiovascular disease and an elevated basal metabolic rate. Twenty-four hours after ingestion of I^{131}, the total amount of radioiodine in the plasma and the amount in the plasma protein were determined and a ratio of these values was calculated. Multiplication of the ratio by 100 gave the "conversion ratio" in per cent. No overlapping of the conversion ratios was found in the hyperthyroid group and in the euthyroid group. The normal values ranged from 13 to 42 per cent in 22 euthyroid patients and from 45 to 96 per cent in 28 patients with hyperthyroidism. Values of less than 10 per cent were considered indicative of hypothyroidism. In subsequent clinical work this ratio has been of considerable value. As the method was first worked out, it was necessary to use doses of 1.0 to 1.5 mc. of I^{131} in order to obtain sufficient counts in 1 c.c. of plasma. Although no adverse reactions have been observed, the desirability of a smaller dose is obvious. Consequently, the method has been revised so that doses between 0.05 and 0.2 mc. are adequate. The details of the modified method are given.

The conversion ratios of 47 patients with various thyroid states are presented.

Two tables.

Direct Measurement of I^{131} Uptake in the Thyroid Gland. Further Observations. A. Stone Freedberg, David L. Chamovitz, Alvin L. Ureles, and Marvin A. VanDilla. J. Clin. Endocrinol. **10:** 910–932, August 1950.

A new method for the quantitative measurement of thyroid gland uptake of I^{131} is described. Four copper cathode Geiger-Müller tubes are connected in a parallel electric circuit and arranged horizontally in a circle with a radius of 45 cm. Each tube is shielded in a 2-inch-thick lead box, a window 10 × 26 cm. remaining. This arrangement fulfills the requirements for a free circle, which is defined as a circle concentric to the outer tube circle, within which a source of I^{131} can be moved with a change in counting rate of less than 5 per cent. The radius of the free circle is 10 cm. The radiation from 12.5 microcuries of I^{131} was found equal to that recorded as background; this sensitivity allows the use of 100 to 150 microcuries as a tracer dose. Mock-up experiments have demonstrated that the determination of thyroid gland uptake by external counting with the four-tube circle, after tracer and therapeutic doses of I^{131}, is in excess by approximately 8 per cent. The measurement, thus corrected, is accurate to ±5 per cent.

Studies of thyroid gland uptakes after tracer doses of I^{131} as measured by platinum (shielded four-tube, platinum cathode, circle radius 60 cm.) and copper circles showed an average difference of −0.25 per cent in 96 comparisons in 25 patients. No correlation could be drawn between this per cent difference and the estimated weight and position of the thyroid gland or the volume and configuration of the neck. Biologic half-lives were determined from measurements in both

"circles"; in 21 comparisons these differed by 5.5 per cent.

The thyroid gland uptake as measured by the copper cathode circle, following tracer and therapeutic doses of I^{131}, was studied in 10 patients. The 24-hour uptake following therapeutic doses of I^{131} differed by an average of 7.4 per cent from the per cent uptake twenty-four hours following tracer doses.

The authors believe the method described offers quantitative accuracy, reduplicability and simplicity in studies of thyroid gland uptake and turnover following tracer and therapeutic doses of I^{131}.

Nine illustrations, including 1 roentgenogram; 9 tables.

Uptake of Radioactive Iodine by the Thyroid Gland of Leukemic Patients. Edwin C. Albright and William S. Middleton. Blood **5:** 764–766, August 1950.

Up to this time most of the evidence adduced to exclude the thyroid gland from responsibility for the increased basal metabolic rate of leukemic patients has been indirect. To establish the status of the thyroid in leukemia, 10 patients with chronic lymphocytic and 5 with chronic myelocytic leukemia were given 100 microcuries of carrier-free I^{131} (8-day half-life) orally under fasting conditions, and the uptake was measured by external counting at a uniform fixed distance (10 cm.) over the thyroid gland twenty-four hours later. Fourteen patients were found to have a normal iodine uptake. In 10 of these the basal metabolic rate was elevated, in 2 it was normal, and in 2 it was not determined. One case showed an uptake in the equivocal range, with a basal metabolic rate of plus 40. Although the series is small, the regularity of the results affords direct evidence of the non-participation of the thyroid gland in the elevation of the basal metabolic rate of leukemic patients.

Treatment of Thyroid Carcinoma with Radioactive Iodine. Sigvard Kaae and Olaf Petersen. Acta radiol. **33:** 539–556, June 1950.

The authors present a review of the literature, in some detail, referable to the treatment of thyroid carcinoma with radioactive iodine, and present their own experiences in several cases.

The body deals with radioactive iodine in the same way as with inactive iodine, that is, there is a selective accumulation in the thyroid tissue, where the concentration will be up to 10,000 times that of the blood.

In view of the good results obtained in the treatment of benign thyrotoxicosis by different methods, and of the still insufficient knowledge of the possible late effects of radioactive substances, the authors report that a warning has been sounded against their use except on very strict indications, that is, repeated recurrences of thyrotoxicosis following operation, severe decompensated heart disease or other lesions contraindicating surgery, and ineffectiveness of or hypersensitivity to substances of the thiouracil group. The criteria are somewhat less strict in the treatment of thyroid cancer. In the presence of inoperable thyroid carcinoma, of recurrence, or of metastases following surgical removal, radioactive iodine may be tried, even in rather large doses. Owing to the very poor prognosis in such cases, the possible late effects cannot influence the indications for treatment to the same extent.

Recent investigations have shown a considerable difference in the uptake of iodine in the different varieties of thyroid carcinoma. It has been estimated that iodine uptake may be expected in about 15 per cent of all cases. It has also been claimed that a higher histologic differentiation is usually attended by a greater iodine-collecting capacity (Rawson *et al.*: Cancer **2:** 279, 1949. Abst. in Radiology **54:** 310, 1950). However, a complete parallelism between the histologic pattern and the power to collect radioactive iodine has not been demonstrated by all investigators.

In a certain number of cases the iodine uptake in metastases from thyroid carcinoma may be increased by surgical removal of the entire thyroid body or destruction of the latter by means of large doses of radioactive iodine. The interval from thyroidectomy until increased iodine uptake is demonstrable in the secondary lesions ranges from one to thirty-two months. The iodine uptake in the metastases may also be increased by administration of thyrotropic hormone or by simultaneous administration of thyrotropic hormone and thiouracil, since it has been found that thiouracil cannot block the iodine uptake in the malignant tissue in cases of thyroid carcinoma. These findings might, therefore, indicate that the mechanism of iodine concentration in thyroid malignant tissue is different from that applying to normal thyroid tissue.

The methods employed to measure the ability of malignant tissue to accumulate iodine are as follows: (1) direct determination of the I^{131} activity in biopsy specimens; (2) histo-autoradiography; (3) measurement *in vivo* of the radioactivity with the Geiger-Müller counter; (4) determination of the activity of the I^{131} excreted in the urine. These methods are discussed in detail.

The authors report their own results in a number of cases of inoperable and recurrent and metastatic carcinoma. One patient with thyrotoxic cancer with remote metastases was in satisfactory condition at the time of the report, seventeen months after treatment. In another case, recurrent following operation, with invasion of the trachea, the tracheal lesion yielded completely to I^{131}. The complications of treatment, in addition to the inevitable myxedema, which is treated by thyroidin, included a depression of the hemopoietic activity of the bone marrow and transient swelling of the submaxillary salivary glands in one instance. No correlation was found between the histologic pattern and the uptake of radioactive iodine in the malignant tissue. Previous roentgen therapy did not prevent concentration of the radioactive isotope, even in considerable amount, in the tumor tissue.

Six histo-autoradiograms; 1 graph.

E. S. KEREKES, M.D.
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Treatment of Thyrotoxicosis with Radioactive Iodine. Edgar S. Gordon and Edwin C. Albright. J. A. M. A. **143:** 1129–1132, July 29, 1950.

The use of radioactive iodine in the treatment of thyrotoxicosis still meets with some opposition because a number of uncertainties relative to the action of the isotope have not been clarified. Some of the unsettled questions are: (1) Is radioactive iodine suitable for the treatment of all forms of toxic goiter? (2) How permanent is the "cure" which ensues? (3) Is there danger of carcinogenesis from the ionizing radiation de-

rived from the isotope? (4) Is there any danger of sterility from this form of treatment? (5) Are there any serious side reactions? (6) May radioactive iodine be used in human subjects of all ages?

The present report deals with the first consecutive 120 cases of hyperthyroidism treated with radioactive iodine at the Wisconsin General Hospital, in which a deliberate attempt has been made to explore as many of these uncertainties as possible. The first patient in this group was treated on May 1, 1947, and the last on Aug. 9, 1949. The patients ranged in age from twelve to seventy-six years; there were 86 females and 34 males, a ratio of 2.6 to 1. In 83 patients the goiters were described as smooth or diffuse, and in 37 as nodular. Twenty-two patients had recurrent thyrotoxicosis treated previously by thyroidectomy; several had had more than one operation. Five women became pregnant either after or during treatment, and 4 have delivered normal infants at term, after uneventful pregnancy and labor. The fifth patient was in her eighth month of pregnancy at the time of the report.

Of the 120 patients, none has failed to respond to therapy, although several have shown an unexpected and unexplained resistance. Remission from a thyrotoxic to a euthyroid state as a result of a single dose of I^{131} is hardly to be expected under a plan of therapy deliberately arranged to induce a step-wise remission. Nevertheless, 59 patients (49.1 per cent) were returned to normal thyroid status with a single dose averaging 3 millicuries; 36 patients were given two doses, with an average total of 5.1 millicuries and with a range of 1.5 to 9.0 millicuries; 16 patients received three doses, with a total averaging 6.29 and a range of 1.9 to 12.7 millicuries, and 7 patients received four doses, with an average total of 10 and a range of 8 to 12 millicuries. Only 2 patients received more than four doses. One of these had seven doses for a total of 20.5 millicuries and the other five doses totaling 12 millicuries.

Five patients in the series have been lost to follow-up through indifference or dissatisfaction, 3 have become hypothyroid, and 3 have died from causes unrelated to the radioiodine therapy. The results otherwise were uniformly excellent. No instances of recurrence have been seen in this series, some of the patients having been followed as long as thirty-three months. No difference in the rate or mode of response was observed in patients with nodular and diffuse goiters. No untoward reactions to the radioactive iodine were seen.

The authors consider the use of radioactive iodine the treatment of choice for toxic goiter, excepting only goiters during pregnancy, large goiters producing mechanical obstruction, and very hard glands suggestive of cancer.

Three charts.

Use of Radioactive Iodine, Radioactive Phosphorus, and Radioactive Sodium in the Determination of Cerebral and Muscle Clearance. Joseph B. Boatman, T. R. Kendrick, F. R. Franke, and Campbell Moses. With the technical assistance of Joseph F. Nechaj. J. Lab. & Clin. Med. **36:** 456–459, September 1950.

In a recent study of the peripheral circulation by Kety (Am. Heart J. **38:** 321, 1949), in which radiosodium was injected intramuscularly, the rate of removal from the injected site is referred to as "clearance" and is considered to be a function of blood flow.

The authors extended Kety's method to brain tissue as well as muscle, and studied clearances of isotopes of radioiodine and radiophosphorus, in addition to radiosodium. The order of decreasing rapidity of clearance in brain and muscle was found to be $I^{131} > Na^{24} > P^{32}$. The expression percentage activity remaining at a stated time was found to provide valid statistical data of clearance measurements. On the basis of their findings, the authors suggest that I^{131} may be used in local tissue clearance determinations instead of Na^{24} where its ease of handling and longer half-life are advantageous.

Two tables.

Blood Volume in Chronic Leucemia as Determined by P^{32} Labeled Red Blood Cells. Nathaniel I. Berlin, John H. Lawrence, and Jean Gartland. J. Lab. & Clin. Med. **36:** 435–439, September 1950.

Because of the nature of chronic leukemia, its treatment presents difficult problems. Sooner or later one is confronted with the signs and symptoms of anemia. The authors, however, have frequently observed patients who have a relatively low red blood cell count but who show little symptomatic evidence of the apparent anemia. Such cases raise the question of the relative value of the red blood cell count as contrasted with the total red blood cell volume.

Since the total oxygen-carrying capacity of the blood is dependent upon the total circulating hemoglobin, which in turn is related to the total red cell volume, the determination of the blood volume would be of considerable assistance in handling patients with chronic anemia. The present study was undertaken to determine the relation between the hematocrit and the total red cell volume, and to investigate the nature of the pathologic physiology of the blood volume in leukemia.

The blood volume was determined with P^{32} labeled red blood cells in 24 cases of chronic lymphatic and 17 cases of chronic myelogenous leukemia. The variation of the total red cell volume for any given hematocrit was found to be so great that the latter is of little or no value for the prediction of the total red cell volume in either normal subjects or patients with chronic leukemia. Three of the 24 patients with lymphatic leukemia had low plasma volumes, 2 had high plasma volumes, and the remaining 19 had normal plasma volumes. Eleven of the 13 patients with myelogenous leukemia who had palpable spleens had high plasma volumes but normal total red cell volumes.

The authors conclude that the determination of the blood volume is of considerable value in the treatment of patients with chronic leukemia.

One chart; 1 table.

Distribution of Radiomercury of a Mercurial Diuretic in Some of the Body Fluids of Man. C. T. Ray, G. E. Burch, S. A. Threefoot, and F. J. Kelly. Am. J. M. Sc. **220:** 160–165, August 1950.

During the course of experiments with mercuhydrin labeled with radiomercury ($Hg^{203, 205}$), various body fluids were obtained for the purpose of studying the relationship of the concentration-time course of the radiomercury in the blood serum to that in the respective body fluids.

Results show that the radiomercury did not escape in high concentrations into the body fluids studied, with the exception of bile. The escape into sweat, cerebrospinal fluid, gastric juice, and erythrocytes was essen-

tially zero, while only low concentrations were reached in edema fluid, saliva, ascitic fluid, and pleural fluid. The concentration in the bile was relatively high, though it did not reach levels encountered in the urine. In 2 patients the ratios of excretion for the bile and urine were 7.2 to 92.8 per cent and 2.7 to 94.2 per cent, respectively.

One table; 3 graphs. RICHARD A. ELMER, M.D.
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Localization of Radioactive Colloids in Lymph Nodes. Leonard A. Walker. J. Lab. & Clin. Med. **36:** 440–449, September 1950.

The object of the present work was to study the quantitative uptake of radioactive colloids by lymph nodes when the colloids were injected intralymphatically or otherwise introduced into the lymphatic channels.

First, attempts were made to cause colloids which had been injected subcutaneously to move from the site of injection into the lymph capillaries, and thence into the nodes. Only radioactive casein left the site of injection, but it did not localize in the regional nodes. Then, a method for intralymphatic injections was developed, and quantitative studies were made on the irradiation of rabbit lymph nodes by means of two radioactive yttrium hydroxy-citrate colloids, called the C and E type colloids. The C type gives an average concentration of radiation in the most active node, as compared with that in the most active tissue, of 284. The type E colloid gives an average of 7,900. Although variation of the volume of colloid injected over the values of 0.05, 0.10, and 0.20 ml. resulted in some change in the percentage uptake by the nodes, these changes were not striking.

It was found that previous intralymphatic injection of yttrium colloids caused an increase in the uptake by the nodes in subsequent injections. No explanation for this effect is offered.

The author suggests that this technic for specific irradiation of lymph nodes might be of use in Hodgkin's disease, in primary lymphosarcoma, or in irradiation of metastases in the nodes, as in cancer of the breast.

One photograph; 5 tables.

RADIATION EFFECTS

Irradiation Necrosis of the Head of the Femur. J. T. MacDougall, A. Gibson, and T. H. Williams. Arch. Surg. **61:** 325–345, August 1950.

This article reviews the literature on radiation necrosis in bone and presents two cases. One patient was a male who received a course of x-ray therapy for a teratoma of the testis—1,170 r (air or skin not specified) to the left side of the abdomen and to each of four pelvic ports, two anterior and two posterior (200 kv.; added filter 2 mm. Cu). Some two years later pain occurred in the left groin, which was thought to be due to metastasis, and x-ray therapy was repeated, a total of 1,200 r being given to the left half of the pelvis and the lumbar region. At this time a film of the left hip was negative, but later films showed a progressive arthritis deformans. At first, there was narrowing of the joint space, some flattening of the femoral head, a subcapital zone of rarefaction in the neck, and osteoporosis. Later, these changes became more pronounced, the head and neck of the femur became sclerotic, and cyst-like changes appeared in the adjacent ilium. An arthroplasty was done and the femur head was found to be rubbery, soft, and compressible. It was easily separated from the viable femoral neck through a well demarcated line of vascular granulation tissue. The basic pathology was an endarteritis obliterans. Other changes were absence of osteoblasts, fibrosis, and fatty degeneration of the marrow and erosion of the trabeculae. There was no evidence of inflammation. The cartilage of the femoral head also showed degeneration.

The second patient was a female who was treated for a cervical cancer as follows: "On Feb. 10, she received 3,600 mg. hours of irradiation by means of radium pack and on Feb. 28 she received 2,400 mg. hours of irradiation by means of radium bomb. From Feb. 12 to April 17 she received 11,600 r units by means of high voltage therapy, six ports being used." Eighteen months later pain occurred in the right hip and a limp developed. A film showed a subcapital zone of rarefaction and sclerosis in the femoral neck. Re-examination after six months showed a definite fracture in this area.

It is estimated that a dose of 2,500 to 5,000 r is necessary to cause an endarteritis obliterans. In the production of radiation necrosis of bone, while the dose of x-rays is of primary importance, other factors, including trauma and blood supply, are also important. In the hip, the limited blood supply of the head and neck of the femur and the trauma of weight-bearing undoubtedly contribute to development of radiation necrosis.

The cartilage, depending on the femoral head for its blood supply, is also affected by avascularity of the head, so that degeneration of the cartilage develops, resulting in an arthritis deformans of the hip. Usually, pain precedes the x-ray evidence of disease by several months.

Five roentgenograms; 5 photomicrographs.
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Postradiation Comedos. Milton S. Hartman. Arch. Dermat. & Syph. **62:** 440–441, September 1950.

Two articles have appeared recently on the development of comedos following roentgen therapy. Bluefarb (Arch. Dermat. & Syph. **56:** 537, 1947. Abst. in Radiology **51:** 294, August 1948) considered this a rare occurrence and attributed it to a compensatory hypertrophy of the pilosebaceous apparatus. Ronchese (Arch. Dermat. & Syph. **61:** 498, 1950. Abst. in Radiology **56:** 162, 1951), on the other hand, thought it not at all unusual and believed the formation to be a cicatricial radiation sequela which should be expected in practically every case, provided the skin is furnished with a normally active pilosebaceous apparatus. Hartman agrees with Ronchese on the incidence of comedos following irradiation but disagrees with both Ronchese and Bluefarb on the mechanism. He considers the process to be one of simple stagnation, with consequent desiccation, of the contents of a gland that has undergone permanent atrophy and the duct and orifice of which have become dilated because of the loss of the epithelial and connective-tissue framework. Mechanical removal of the dried plug will spell the end of the comedo, since it cannot recur because of the permanent arrest of function of the gland.

Placental Barrier in Carbon Monoxide, Barbiturate and Radium Poisoning: Some Original Observations in Humans. Harrison S. Martland and Harrison S. Martland, Jr. Am. J. Surg. **80:** 270–279, September 1950.

The authors made radioactivity tests on 17 children of 10 mothers who had previously been watch dial painters. Only one of the children was born while the mother was still engaged in dial painting; the rest were born from two to fifteen years after their mothers had left that occupation. Seven of the 10 mothers died from poisoning by radioactive substances ingested while licking brushes as they worked.

Two methods of measurement were employed. By the first the authors were able to detect approximately 55 per cent of the total body radium by measuring the gamma rays from fixed deposits in the body. By the second, they were able to detect approximately 45 per cent of the total body radium by measurement of the radon gas given off in the expired air. The two methods complement each other, the second being much more sensitive than the first.

None of the children showed an appreciable amount of radioactivity in excess of 0.01 microgram, which is within the upper limits of normal for the human body. This does not prove that the placental barrier is not crossed by the radioactive gaseous compounds present in the mother's blood, but that, should it be so crossed, radioactive deposits in the children are too small to produce harmful effects, taking into consideration the figure 0.1 microgram as total body radium accumulation, above which there is a potential danger.

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Influence of Grenz Rays on Histamine-Induced Manifestations. Gustav Bucky, Frederick Blank, and Irving H. Distelheim. Arch. Dermat. & Syph. **62:** 319–322, August 1950.

The present study was undertaken in an attempt to answer the question "Do grenz rays exert any antihistaminic effect?"

The inner surfaces of the forearms were employed for the experiment, and the histamine solution was introduced by iontophoresis. After preliminary investigations showed that the most pronounced irradiation effect was delayed from four to six hours, the volar aspect of one forearm was irradiated with 300 r of grenz rays (h.v.l. 25 microns of aluminum; 15 ma.) four to six hours before the introduction of the histamine solution. Readings were taken immediately after the histamine introduction, after twenty minutes, after six hours, and after twenty-four hours. Forty persons were treated in the manner described. Twenty-two (55 per cent) showed an increased local reaction to histamine after grenz irradiation. Eight (20 per cent) showed a decreased local reaction to histamine after grenz irradiation. In 10 (25 per cent) the responses were equivocal. An interesting observation was that increased reactivity to histamine after irradiation was present in 6 of the 7 patients with allergic backgrounds.

The authors' results tend to disprove the original contention that local grenz irradiation produces any antihistaminic substances locally. Whether indirect irradiation will produce such substances will have to be determined in later experiments.

One illustration; 2 tables.

Effect of Vitamin B_{12} on the Leukopenia Induced by Radiation. Robert E. Carter, Elizabeth Busch, and Verda Strang. Blood **5:** 753–757, August 1950.

Vitamin B_{12}, a highly active liver principle containing cobalt and an active growth-stimulating substance for *Lactobacillus lactis*, has been shown to be effective in the treatment of addisonian pernicious anemia and other macrocytic anemias. Through the ability of thymidine to replace B_{12} as a growth factor for *Lactobacillus lactis*, it has been postulated that B_{12} acts as a co-enzyme in the transformation of thymine to thymidine.

In view of the diverse theories of the mechanism by which radiation affects living tissue, and in view of the possibility that the formation of nucleoprotein may be interfered with, a trial of the effects of vitamin B_{12} on the leukopenia following radiation was undertaken.

Fifty-four rats, weighing 100 to 150 gm., were divided into six groups. Three groups were given 400 r of 250-kv. x-radiation, while the other three were not irradiated. Four groups were given varying amounts of B_{12}; two groups received no vitamins.

The dosage of radiation was sufficient to produce a profound leukemia. No statistically significant anemia resulted from 400 r, but the fact that all values for the exposed groups lie below the control mean is of moderate significance in itself. Groups receiving vitamin B_{12} showed no difference in the degree of neutropenia or lymphopenia following the radiation, as compared with non-injected exposed groups. Similarly, vitamin B_{12} given to non-exposed animals produced no significant change in the absolute number of neutrophils or lymphocytes. The bone marrow biopsies showed no difference between the animals receiving vitamin B_{12} and those not given the vitamin. The radiation administered caused a marked decrease in the cellularity of the femoral marrow nine days after exposure, following which recovery was rapid. The normoblastic and leukoblastic series were equally affected. No consistently significant alteration in the hemogram of non-irradiated animals receiving vitamin B_{12} was seen.

Four charts; 1 table.

Effect of Cysteine on the Peripheral Blood of the Irradiated Rat. Harvey M. Patt, Douglas E. Smith, and Eugenia Jackson. Blood **5:** 758–763, August 1950.

Earlier studies (Science **110:** 213, 1949) revealed that cysteine is highly effective in protecting rats against lethal x-irradiation. There is reason to believe that the amino acid, perhaps by preventing oxidations by free radicals, neutralizes a portion of the radiation and thereby decreases its biologic effectiveness. Since the formed elements of peripheral blood are very sensitive indicators of radiation damage, they were selected to evaluate further the influence of cysteine on the irradiated animal.

Control and experimental rats, weighing 150 to 250 gm., were irradiated simultaneously, receiving 800 r in a single whole-body exposure, at 250 kv. In the experimental series, cysteine (950 mg. per kg., pH 7–8) was injected into a tail vein five minutes before irradiation, while the controls received an intravenous injection of 5 per cent sodium chloride. Non-irradiated control groups were similarly treated. The results revealed that cysteine significantly modified the radiation-induced hematologic changes.

The white blood elements of the irradiated controls showed a maximal depression four days after the expo-

sure. Significant recovery was evident three weeks after irradiation and was essentially complete within forty days. Changes in the leukocyte count of the irradiated rats pretreated with cysteine was less severe. Maximal depression in the latter group also appeared four days after the exposure, but definite recovery was manifest considerably earlier (ten days post-irradiation). The leukocyte count of non-irradiated controls was increased for several days after a single injection of either cysteine or sodium chloride.

Radiation-induced changes in the heterophils and lymphocytes were diminished in rats pretreated with cysteine, and recovery occurred significantly sooner. An increase of borderline significance was observed in the heterophil count of the irradiated controls one day after exposure. Marked depression of heterophils was noted at four, seven, ten, and fourteen days, and significant recovery toward the normal at twenty-one days. In the irradiated rats receiving cysteine, as well as in cysteine-treated controls, a significant rise in the heterophils was evident one day after the injection. The heterophils of cysteine-treated irradiated rats were depressed significantly below the normal four days after exposure, and appreciable recovery was evident at seven days.

Maximal depression of lymphocytes in the irradiated controls appeared four days after the exposure. The lymphocytic elements remained depressed until the twenty-first day, when definite recovery was noted. In the cysteine irradiated group, maximal depression occurred on the first day and significant recovery was apparent by the tenth day after the irradiation. An increased lymphocyte count was seen in both of the non-irradiated control groups (cysteine and sodium chloride) on the first and fourth days after the injection.

The number of circulating erythrocytes in the irradiated controls fell sharply ten days after the exposure and the maximal anemia occurred at twenty-one days. The erythrocyte count returned toward normal at twenty-eight days and recovery was essentially complete by forty days. A comparatively small decrease in the erythrocyte count was seen ten days after exposure in irradiated rats pretreated with cysteine. The erythrocyte level was rapidly restored in these animals, recovery being completed by twenty-eight days.

Five charts.

Changes in Blood Plasma of Guinea-Pig During Acute Radiation Syndrome. Henry I. Kohn, with the technical assistance of Nancy Swingley and W. J. Robertson. Am. J. Physiol. **162:** 703–708, Sept. 1, 1950.

The plasma of the guinea-pig was studied during the eight days following a single total-body exposure to 250-kv. x-rays. The changes came in two phases with respect to time, the first phase beginning within one day of exposure, the second phase beginning about three or four days later and corresponding to the time when the first serious symptoms were observed. The magnitude of change after 200 r, the approximate LD 50, was about one-half that after 600 r (total protein excepted), but the patterns of change in all cases were alike.

After 200 r, the following changes occurred: Glucose concentration rose 60 mg. per cent during the first day and gradually returned to normal during the next five days. The non-protein nitrogen was elevated by 10 mg. per cent for five days. The albumin-globulin ratio rose from a normal of 3.1 to 4.5 during the first two days, and returned to normal during the next three days. The rise was due to non-protein material which could be rendered ineffective by extraction of the plasma with ether. The total protein level fell about 1 gm. per cent during the fifth to seventh days after exposure. The chloride concentration was elevated by 20 mg. per cent during the fourth to fifth days. Cholesterol was elevated by 20 mg. per cent during the fourth to fifth days.

A peculiar transient syndrome was also noted during the one or two hours immediately following exposure, especially after 600 r, consisting in abnormal posture, labored respiration, and lacrimation.

One chart.

Effects of X-Rays Produced at 50 Kilovolts on Different Species of Bacteria. Harvey Fram, Bernard E. Proctor, and Cecil G. Dunn. J. Bacteriol. **60:** 263–267, September 1950.

The effects of irradiation with x-rays produced at 50 kv. were studied with six bacteria, namely, *Escherichia coli, Aerobacter aerogenes, Staphylococcus aureus, Serratia marcescens, Pseudomonas aeruginosa,* and *Pseudomonas fluorescens.*

The rate of destruction followed a first-order reaction.

The dosage of x-rays necessary to destroy 63 per cent of the bacteria (or, conversely, the dosage permitting 37 per cent survival) was determined. *Staphylococcus aureus* was found to be the most radioresistant of the bacteria studied.

The percentage of bacteria of a given species killed by a specific total dosage of x-rays was the same regardless of the initial concentration of bacteria in the suspension irradiated. The results indicated that the bacteria were destroyed by soft x-rays according to the "direct hit" theory of radiation.

Two charts; 2 tables.

On the Effect of Roentgen Rays upon Some Simple Aliphatic Brom Compounds. A. Meister and W. Minder. Radiol. clin. **19:** 238–257, July 1950. (In German)

The object of the investigation reported here was to verify by means of irradiation of simple bromine compounds of methane and the simple members of the paraffin series, the validity of laws as to the effect of roentgen irradiation which were deduced from a previous study with the halogen compounds of benzole (benzene). More specifically, the questions to which an answer was sought were: (1) the dependence of the radiation reaction upon the concentration of the solutions, (2) the number of halogen substitutes, and (3) the effect attributable to the size of the molecules.

In the experiments performed with different aqueous concentrations of bromoform, of tetrabrom-methane, and of the monobromides of the simple paraffins, quantitative measurements of the hydrobromic acid resulting from irradiation were expressed in terms of the specific electric conductivity. The experiments were done with the Philips contact therapy unit. The volume dose varied from 1,300 to 60,000 r. The results obtained were as follows:

1. Bromoform in saturated aqueous solution was decomposed with resulting hydrobromic acid formation.

2. Roentgen irradiation of an aqueous solution of tetrabrom-methane also produced hydrobromic acid.

3. Hydrobromic acid was likewise produced by irradiation of aqueous solutions of the monobromides of the simpler paraffins.

4. Production of hydrobromic acid, when expressed in terms of so-called ion yield, is in the case of bromoform M/N = 1.1, and in the case of tetrabrom-methane M/N = 0.76 molecules/ion. With monobromide compounds of the simple paraffins, the ion-yield in aqueous solutions is the smaller the greater the length of the carbon chain, the relationship being approximately an exponential one.

5. Irradiation of dry bromoform likewise resulted in the formation of hydrobromic acid when the irradiated substance was dissolved in water. In this instance, however, the yield of hydrobromic acid obtained from equal quantities of bromoform is some twenty times less than from an aqueous solution. By contrast, the ion yield is considerably greater than 1.

6. Irradiation of dry tetrabrom-methane did not produce ascertainable amounts of hydrobromic acid.

7. An attempt is made to explain the results obtained. The target theory and the chemical effects of ionizing radiations are discussed.

Seven tables; 12 graphs.

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